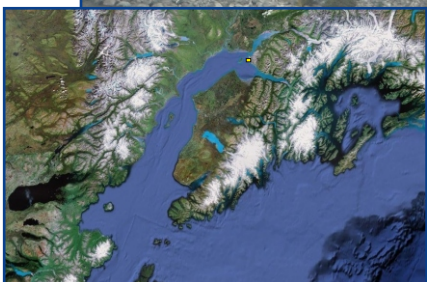
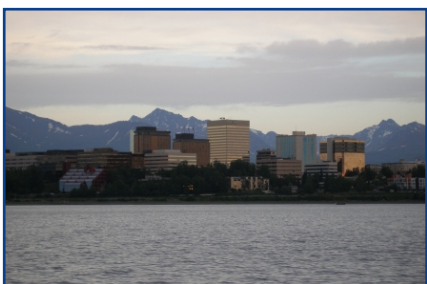


MONITORING PROGRAM ANNUAL REPORT

JANUARY - DECEMBER 2014

ANCHORAGE WATER AND WASTEWATER UTILITY JOHN M. ASPLUND WATER POLLUTION CONTROL FACILITY AT POINT WORONZOF



Prepared for:



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February 2015

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NPDES Permit AK-002255-1

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PREFACE

This Monitoring Program Annual Report was prepared for the U.S. Environmental Protection Agency (EPA) to fulfill requirements of the National Pollutant Discharge Elimination System (NPDES) Permit AK-002255-1, for discharge from the John M. Asplund Water Pollution Control Facility (WPCF), operated by the Anchorage Water and Wastewater Utility (AWWU) at Point Woronzof under authority of the Municipality of Anchorage (MOA). This NPDES permit incorporates provisions necessitated by the Clean Water Act (CWA), Section 301(h), for variance from the requirements of secondary treatment.

Elements of the monitoring program are:

- Influent, Effluent, and Sludge Monitoring
 - In-Plant Sampling
 - Toxic Pollutant and Pesticide Sampling
 - Pretreatment Monitoring
 - Whole Effluent Toxicity Monitoring
- Receiving Water Quality Monitoring
 - Plume Dispersion
 - Intertidal Zone Bacteria
- Sediment and Bioaccumulation Monitoring
 - Sediment Analyses
 - Bioaccumulation Analyses

During 2014, the monitoring program consisted of two influent, effluent, and sludge toxic pollutants and pesticides sampling and analysis efforts, one receiving water quality sampling and analysis effort, and quarterly whole effluent toxicity (WET) testing. In addition, AWWU conducted permit required daily, weekly, and monthly self-monitoring for influent, effluent, and sludge. The sediment and bioaccumulation components of the monitoring program were originally conducted once each during 2003 and 2004 and have not been performed since, as the current NPDES permit only required those components be performed once.

This annual report provides information and data pertaining to the monitoring program performed to meet the requirements as set forth in the NPDES permit that became effective on 2 August 2000. The report covers the period of 1 January through 31 December 2014.

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C7	Hydrographic Data Profiles Kinnetic Laboratories, Inc.
C8	Field Data Sheets Kinnetic Laboratories, Inc.

ACRONYMS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADT	Alaska Daylight Time
ANOVA	Analysis of Variance
ASTM	American Society for Testing and Materials
Avg or AVG	Average or Mean
AWQS	State of Alaska Water Quality Standard
AWWU	Anchorage Water and Wastewater Facility
B	Analyte was present in the associated method blank (Data Qualifier)
BETX	Summation of Benzene, Ethylbenzene, Toluene, and Xylene
BOD ₅	5-Day Biochemical Oxygen Demand
CFR	Code of Federal Regulations
COC	Chain of Custody
CTD	Conductivity, Temperature, and Depth Profiler
CWA	Clean Water Act
DCS	Duplicate Control Spike
DGPS	Differential Global Positioning System
DI	Deionized
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
Eff or EFF	Effluent
EPA	U. S. Environmental Protection Agency
FB	Field Blank
FC	Fecal Coliform Colonies
FWPCA	Federal Water Pollution Control Act
GC	Gas Chromatography
H ₂ SO ₄	Sulfuric Acid
HCl	Hydrochloric Acid
HEM	N-Hexane Extractable Material
Hg	Mercury
HNO ₃	Nitric Acid
i	MRL/MDL elevated due to chromatographic interference (Data Qualifier)
Inf or INF	Influent
J	Estimated value (Data Qualifier, below MRL, but above MDL)
KLI	Kinnetic Laboratories, Inc.
LCS	Laboratory Control Spike
LOEC	Lowest Observed Effect Concentration
MAEC	Maximum Allowable Effluent Concentration
Max	Maximum
MB	Method Blank
MDL	Method Detection Limit
Min	Minimum
MLLW	Mean Lower Low Water
MOA	Municipality of Anchorage
MPN	Most Probable Number
MRL	Method Reporting Limit
MS	Matrix Spike

MSD	Matrix Spike Duplicate
NA	Not Applicable or Not Available
Na ₂ S ₂ O ₃	Sodium Thiosulfate
NACWA	National Association of Clean Water Agencies
NaOH	Sodium Hydroxide
ND	Not Detected
NIST	National Institute of Standards and Technology
NOAA	National Oceanographic and Atmospheric Administration
NOEC	No Observed Effect Concentration
NOS	National Ocean Service
NPDES	National Pollutant Discharge Elimination System
NT	Not Tested
O&G	Oil and Grease
ORP	Oxidation Reduction Potential
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
pH	Hydrogen potential
POTW	Publicly Owned Treatment Works
PQL	Practical Quantitation Limit
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
Rep	Replicate
RPD	Relative Percent Difference
SOP	Standard Operating Procedure
SRM	Standard Reference Material
SSI	Sewage Sludge Incinerator
SSWQC	Site-Specific Water Quality Criteria
TAC	Test Acceptance Criteria
TAH	Total Aromatic Hydrocarbons
TAqH	Total Aqueous Hydrocarbons
TB	Trip Blank
TCDD	Dioxin 2,3,7,8-tetrachlorodibenzo-p-dioxin
TIE	Toxicity Identification Evaluation
TPAH	Total Polycyclic Aromatic Hydrocarbons
TRC	Total Residual Chlorine
TRE	Toxicity Reduction Evaluation
TSS	Total Suspended Solids
U	Not detected
WET	Whole Effluent Toxicity
WPCF	Water Pollution Control Facility
WWTF	Wastewater Treatment Facility
ZID	Zone of Initial Dilution

UNITS AND SYMBOLS

°	degrees
'	minutes
"	seconds
>	greater than
≥	greater than or equal to
<	less than
≤	less than or equal to
%	percent
‰	parts per thousand
° C	degrees Celsius
cm	centimeter(s)
cm/s	centimeters per second
FC/100 mL	Fecal Coliform Colonies per 100 milliliters
ft	foot or feet
g	gram(s)
hr	hour(s)
in	inch(es)
km	kilometer(s)
L	Liter(s)
lb	pound(s)
m	meter(s)
min	minute(s)
mgd or MGD	million gallons per day
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter(s)
MPN/100 mL	Most Probable Number per 100 milliliters
NTU	Nephelometric Turbidity Units
ppt	parts per thousand
psu	practical salinity units
TUc	Chronic Toxicity Units
µg/g	micrograms per gram
µg/L	micrograms per liter

SUMMARY

PURPOSE

This report was prepared to meet requirements of the U.S. Environmental Protection Agency (EPA) and Alaska Department of Environmental Conservation (ADEC) as outlined in the National Pollutant Discharge Elimination System (NPDES) Permit AK-002255-1, signed on 30 June 2000 and effective on 2 August 2000. This permit authorizes discharge of effluent from the John M. Asplund Water Pollution Control Facility (Asplund WPCF). Wastewater from the Municipality of Anchorage (MOA) is treated at this facility before discharge to the receiving waters of Knik Arm in Cook Inlet, Alaska. The NPDES permit incorporates requirements of the Clean Water Act (CWA) for a 301(h) variance from secondary treatment and is in compliance with provisions of the Federal Water Pollution Control Act as amended by the CWA (33 U.S.C. §1251 et seq.) and the Water Quality Act of 1987.

HISTORY

In September 1979, AWWU submitted to the EPA a 301(h) secondary treatment variance application proposing an improved discharge which eliminated chlorination and required the addition of both a 610-meter (m) extension and a 305-m diffuser to the Asplund WPCF outfall. The outfall extension was intended to move the point of discharge beyond the negative influence of a gyre that was reported to exist off Point Woronzof on a flood tide and was presumed to carry effluent toward shore, causing bacterial contamination of the shoreline.

Further studies were subsequently undertaken to derive design criteria for the outfall improvements. The central issue was to evaluate outfall design alternatives and the chlorination/no chlorination option in relation to a system of eddies that occur on the flood tide. These studies were completed as an *Amendment to Wastewater Facilities Plan for Anchorage, Alaska* (CH2M Hill et al., 1985). This amended plan recommended the use of the existing 245-m outfall with the addition of a three-nozzle diffuser. It was shown that chlorination would still be required to meet bacterial standards even with an extended outfall and diffuser. Because the same water quality standards could be met by chlorinating and installing an improved diffuser at the end of the existing outfall, there was no need to extend the outfall.

Concurrent with the studies to amend the facilities plan, a revised CWA 301(h) variance application was submitted to the EPA. After extensive EPA review, public comment, and hearings, the Final Permit Decision was issued by EPA and the five-year NPDES permit became effective 16 October 1985 (EPA, 1985a). As required by this permit, a multi-port diffuser was installed in August 1987 prior to the second year of receiving water sampling. Fourteen years of monitoring were performed under the initial 1985 NPDES permit.

AWWU submitted an application to renew the CWA 301(h) variance from secondary treatment in 1990. A more recent application was submitted in 1998 with additional monitoring data and information provided to EPA in 1999. A draft NPDES permit that incorporated the 301(h) variance was issued in 1999 and a renewed permit was signed by EPA in June 2000 to become effective on 2 August 2000 for five years. The permit was administratively extended in August 2005 pending a permit renewal decision from EPA. The most recent application for a reauthorization of the NPDES permit and CWA 301(h) variance was submitted in January 2005 and is currently being reviewed by the EPA. In addition, AWWU has since conducted a number

of special studies, including the preparation of an evaluation of effects on endangered species in support of the permit renewal as a result of the Cook Inlet beluga whale being listed as an endangered species (CH2M Hill, 2011).

RECEIVING WATER ENVIRONMENT

The Asplund WPCF discharges into the Knik Arm of Cook Inlet, a unique body of estuarine water with extremely high tidal fluctuations (over 39 feet [12 meters] with a mean range of 26.2 feet [7.98 meters] at Anchorage; NOAA/NOS, 2014). These fluctuations produce extensive tidal flats, swift tidal currents of 4 - 6 knots, and intense mixing within Cook Inlet. The continual input of sediments, combined with the re-suspension of bottom sediments due to high bottom shear stress with each tidal cycle, results in naturally high suspended sediment concentrations of over 2,500 milligrams/liter (mg/L) in Knik Arm (KLI, 2007b). This sediment originates primarily from riverine and glacial melt waters flowing into Cook Inlet and Knik Arm from the Eagle, Knik, Matanuska, and Susitna Rivers.

Large temperature extremes occur between summer and winter. In the winter, ice can reach thicknesses of 1 - 2 meters (m) and consists of broken pieces due to the large tides and currents. An important consideration to this monitoring study is the large volume of saline ocean water entering Cook Inlet that is vertically mixed with the riverine and glacial inputs by tidal turbulence which allows this water body to be very effective in wastewater dilution and assimilation within the marine environment.

MONITORING OBJECTIVES

The monitoring conducted during 2014 consisted of two main components: (1) in-plant monitoring of influent, effluent, and sludge, including whole effluent toxicity testing; and (2) receiving water quality monitoring in the vicinity of the discharge and mixing zone, and at a control site across Knik Arm. Objectives of the 2014 program as outlined in the permit are:

2014 MONITORING OBJECTIVES

Influent, Effluent, and Sludge Monitoring

- Determine compliance with the NPDES permit and State of Alaska water quality standard (AWQS) criteria
- Determine effectiveness of the industrial pretreatment program
- Aid in assessing the water quality at discharge point
- Characterize toxic substances
- Monitor plant performance
- Determine compliance with the regulatory criteria of Section 301(h) of the CWA
- Provide data for evaluating re-issuance of the NPDES permit

Receiving Water Quality Monitoring

- Determine compliance with the NPDES permit and AWQS criteria
- Aid in assessing the water quality of the receiving water
- Determine compliance with the regulatory criteria of Section 301(h) of the CWA
- Determine the level of bacterial concentrations in nearshore waters
- Provide data for evaluating re-issuance of the NPDES permit

2014 MONITORING RESULTS

As part of its self-monitoring program, AWWU conducted daily, weekly, and monthly sampling of influent, effluent, and sludge, depending on the parameter measured. In addition, monitoring for toxic pollutants and pesticides was conducted twice during 2014, once in June and once in August. Whole effluent toxicity testing was conducted quarterly and receiving water quality monitoring was performed once in June. The following summarizes results of this year's monitoring based on the permit requirements:

Influent, Effluent, and Sludge

- Influent, effluent, and sludge chemical monitoring showed, that with no exceptions, the Asplund WPCF met the NPDES permit requirements and complied with all applicable AWQS. AWWU's self-monitoring of total residual chlorine (TRC), pH, 5-day biological oxygen demand (BOD₅), and total suspended solids (TSS) showed compliance with all permit effluent limitations throughout 2014.
- AWWU's self-monitoring of TRC and pH showed that the permit limit for daily maximum TRC levels in the effluent was never exceeded and pH was within permit limits throughout 2014.
- The permit limit for the monthly maximum geometric mean of 850 fecal coliform colonies per 100 mL (FC/100 mL) was not exceeded in 2014. The fecal coliform monthly criterion "that not more than 10% of the effluent samples shall exceed 2600 FC/100 mL" was not exceeded in 2014.
- AWWU's self-monitoring of TSS and BOD₅ showed compliance with all regulatory and permit effluent limitations. TSS and BOD₅ were well within the daily, weekly, and monthly criteria for the entire year. Average monthly removals for BOD₅ and TSS of $\geq 30\%$ are required by the amendment to the CWA (40 CFR Part 125; Final Rule). The removal rate for both TSS and BOD₅ met the 30% minimum removal requirement for all months during 2014. Annual removals were 77.3% for TSS and 42.8% for BOD₅ which indicate an exceptional level of primary treatment is being achieved.
- Total aromatic hydrocarbons (TAH), total aqueous hydrocarbons (TAqH), and total ammonia concentrations in the effluent were all found to be below their maximum allowable effluent concentrations (MAECs) as calculated from AWQS throughout 2014.
- Concentrations of metals and cyanide in the effluent never exceeded their MAECs at any time during any of the 2014 monitoring events.
- Concentrations of toxic pollutants and pesticides, including metals and cyanide, in the influent and effluent were all within the established range or lower than values from a national study of secondary treatment plants (EPA, 1982a).
- Toxic pollutant sludge concentrations were found to be very low compared to the limits established under 40 CFR Part 503 and all were within the range or lower than values from a national study of secondary treatment plants. All metals fell at or below the typical concentrations and were well below the 95th percentile worst case values (EPA, 1985c).
- Results from quarterly whole effluent toxicity testing were below the permit trigger level that would require additional testing for all tested species and events in 2014.

Water Quality

- Little variation among stations was observed for most hydrographic parameters indicating that the receiving water environment is uniform and well mixed near the outfall.
- To test the hypothesis that water quality at the zone of initial dilution (ZID) boundary was not degraded with respect to water quality at nearfield and control stations, statistical comparisons were made. Salinity and temperature did show statistically significant differences between sites; however, these were not ascribed to the outfall but were due to river influences at the control stations. No statistically significant differences were seen for dissolved oxygen (DO), pH, TRC, TSS, turbidity, or fecal coliform.
- Fecal coliform concentrations in receiving water and intertidal samples were found to be low at all locations. AWQS criteria of a median of not more than 14 FC/100 mL, a geometric mean of not more than 20 FC/100 mL, and of not more than 10% of the samples exceeding 40 FC/100 mL were met at all receiving water and intertidal locations including stations located within the mixing zone boundary.
- Supplemental receiving water samples obtained as part of the plume monitoring indicated that all dissolved metals were below their AWQS at all locations except for one copper sample located at the outfall. No statistically significant differences between the outfall and control station groupings were seen for any dissolved metal. Total metals were elevated compared to the dissolved as a result of the naturally high suspended sediment load. No statistically significant differences were seen for any total recoverable metal.
- All cyanide concentrations in the receiving waters were found to be below the receiving water quality criterion limit of 1.0 µg/L. No statistically significant differences were detected between concentrations at the control and outfall stations.
- Supplemental receiving water samples also demonstrated that TAH and TAqH met the AWQS at all locations.
- TRC was below the detection limit of 10 µg/L at all locations, as compared to the AWQS of 7.5 µg/L for chronic, 13.0 µg/L for acute marine water use, and 100 µg/L as ADEC's practical quantitation limit for regulatory purposes. Based on the highest maximum daily effluent TRC concentration and a 180:1 dilution credit, it is estimated that maximum TRC at the ZID boundary would be 5.2 µg/L and therefore met all AWQS for TRC.
- Turbidity and color met the AWQS at all locations. Turbidity and color did not exceed natural conditions and color did not exceed 15 color units at any receiving water location.

CONCLUSIONS

Results from the past year of the monitoring program confirm years of previous studies, data in the NPDES permit and 301(h) variance renewal application, and the decision by the EPA to reissue the NPDES permit with 301(h) variance. The Asplund WPCF is operating within regulatory requirements with no exceptions during 2014 and is showing no measurable impacts to the marine environment. In addition to the exceptional performance seen in 2014, the Asplund WPCF received the Platinum Award from the National Association of Clean Water Agencies (NACWA) in 2013 after five consecutive years of Gold Awards that were given to Asplund WPCF for exceptional levels of plant performance and permit compliance.

1.0 INTRODUCTION

1.1 REGULATORY/ENVIRONMENTAL BACKGROUND

This monitoring program is designed to meet the requirements of the NPDES Permit AK-002255-1 which authorizes discharge of municipal effluent into the Knik Arm of Cook Inlet receiving waters from the John M. Asplund WPCF, operated by AWWU under authority of the MOA (Figure 1). The NPDES permit, which became effective on 2 August 2000, incorporates requirements necessitated by the CWA 301(h) secondary treatment variance and is in compliance with provisions of the Federal Water Pollution Control Act as amended by the Clean Water Act (CWA 33 U.S.C. §1251 et seq.) and Water Quality Act of 1987, P.L. 100-4.

1.1.1 Regulatory Background

In 1972, while the Asplund WPCF and its outfall were being built, the Federal Water Pollution Control Act (FWPCA) was amended to establish two phases of effluent limitations applicable to all Publicly Owned Treatment Works (POTWs). Under Section 301(b), POTWs were required to achieve secondary treatment of effluent by 1 July 1977 and the "best practicable waste treatment technology" by July 1983.

Congress again amended the FWPCA in 1977. Section 301(h) was added, providing that the EPA Administrator, upon application from a POTW and with the concurrence of the State, might issue an NPDES permit modifying the requirements of Section 301(b). On 15 June 1979, EPA promulgated the regulations regarding issuance of a variance from secondary treatment to an applicant discharging into certain ocean and estuarine waters and demonstrating compliance with the 301(h) criteria.

In September 1979, AWWU submitted to the EPA a 301(h) variance application proposing an improved discharge which eliminated chlorination and required the addition of both an extension and diffuser to the Asplund WPCF outfall. Earlier studies had recommended construction of a 610-m outfall extension and a 305-m diffuser. The proposed extension/diffuser reportedly could meet fecal coliform receiving water standards without chlorination and prevent shore contact of the wastewater plume.

As a parallel program, AWWU undertook preparation of a wastewater master plan for the Anchorage area. The resultant Wastewater Facilities Plan for Anchorage, (Ott Water Engineers, Inc. et al., 1982) and the Environmental Impact Statement, City of Anchorage, Alaska, Wastewater Facilities (EPA and Jones & Stokes, 1982) were accepted by the EPA and ADEC.

Further studies were subsequently undertaken to derive design criteria for outfall improvements. Significant efforts were included to improve reconnaissance level data upon which the outfall length and diffuser design were to be based and to evaluate bacterial standards applicable to Knik Arm. The central issue was to evaluate outfall design alternatives and the chlorination/no-chlorination option in relation to the presence of a system of eddies that occur east of Point Woronzof on the flood tide and that might be capable of transporting the effluent plume shoreward. These latter studies were completed as an Amendment to the Wastewater Facilities Plan for Anchorage, Alaska (CH2M Hill et al., 1985). This amended plan recommended using the existing 245-m outfall with the addition of a three-nozzle diffuser. It was concluded that chlorination would still be required to meet bacterial standards even with an extended outfall and

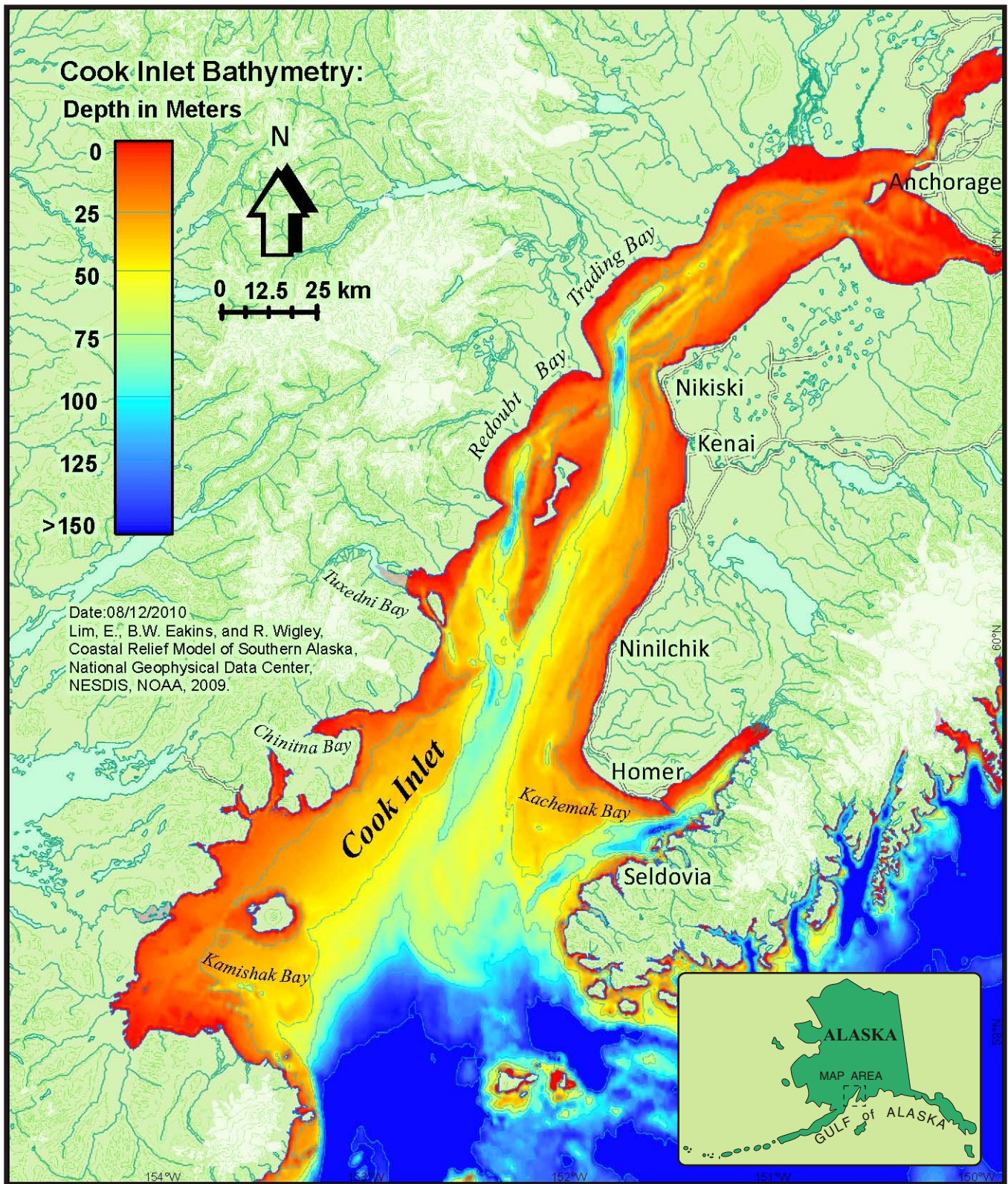


Figure 1. General Study Area and Bathymetry.

diffuser. Because the same standards could be met by use of chlorination and the existing outfall, there was no need to extend the outfall. With continued chlorination, all water quality standards were predicted to be met by the amended facilities plan.

Concurrent with studies to amend the facilities plan, a revised application entitled Application for Modification of Secondary Treatment Requirements, Section 301(h), Clean Water Act was submitted to EPA (CH2M Hill et al., 1984). The EPA Region 10 301(h) Review Team's Tentative Decision Document, entitled Analysis of the Section 301(h), Secondary Treatment Variance Application for the John M. Asplund WPCF (EPA, 1985b), and a draft NPDES permit were made available for public comment on 17 January 1985. After comments and appropriate hearings, the Final Permit Decision (EPA, 1985a) was issued 13 September 1985, and the start date of the five-year NPDES Permit AK-002255-1 was listed as 16 October 1985. As required by this permit, a multi-port diffuser was installed at the Asplund WPCF outfall in the beginning of August 1987. This occurred prior to the 1987 summer water quality monitoring program. This original NPDES permit expired on 15 October 1990.

AWWU submitted a renewal application for the permit in April 1990 which addressed amendments made to the 301(h) provisions by the Water Quality Act. That renewal application was not acted upon by the EPA and the facility continued to operate under an administrative extension of the 1985 permit until August 2000. In 1998 it was projected that the growth of Anchorage would result in the discharge limits contained in the 1985 permit being exceeded within a few years. Therefore, AWWU prepared and submitted another renewal application which replaced the 1990 application in October 1998 (CH2M Hill, 1998).

In tandem with the renewal application, AWWU conducted special studies and submitted a request for site-specific water quality criteria (SSWQC) to the ADEC for the Point Woronzof area of Cook Inlet in December 1998. This request for SSWQC was for turbidity and a suite of metals and was necessitated because the Alaska Water Quality Standards (AWQS) for marine waters could not be achieved for these waters as a result of the naturally high suspended sediment loads in Cook Inlet due to glacial inputs. The approach to the request was based on the EPA's Metals Policy that had been recently promulgated which recommends the use of only the dissolved fraction of metals as bioavailable and appropriate for the protection of aquatic life and associated beneficial uses of the water body. Following both agency and public review and comments, the SSWQC were incorporated into the AWQS as amended on 27 May 1999. The SSWQC for the Point Woronzof area included turbidity and the dissolved fraction of arsenic, cadmium, hexavalent chromium, copper, lead, mercury, nickel, selenium, silver, and zinc.

Following the promulgation of these new AWQS, a tentative decision to grant AWWU its 301(h) variance was made by EPA on 4 November 1999. The tentative decision, draft NPDES permit, and permit fact sheet were then made available for public review and comments. The State of Alaska's Division of Government Coordination issued its Final Consistency Determination for the action in February 2000. The current NPDES permit for the Asplund WPCF was signed by the EPA and went into effect 2 August 2000 for five years; it was then administratively extended in August 2005 pending permit renewal. The most recent application for a reauthorization of the permit with 301(h) variance was submitted in January 2005 and is still under review by the EPA. In addition, AWWU performed a number of special studies including preparation of a biological evaluation and analyses of constituents of emerging concern in support of the permit renewal as a result of the Cook Inlet beluga whale being listed as an endangered species in October 2008 (CH2M Hill, 2011).

The NPDES permit specifies the required monitoring program. The Monitoring Program Work Plan (Kinnetic Laboratories, Inc., 2000a), submitted to EPA in October 2000, identified how AWWU intends to fulfill the requirements of this monitoring program. This annual report documents the progress and results of the monitoring program that was performed in 2014.

Since issuance of the current NPDES permit, EPA has approved ADEC's use of dissolved metals for the AWQS, approved all proposed SSWQC for Upper Cook Inlet in the vicinity of Point Woronzof, and removed Alaska from the National Toxic Rule (EPA, 2006). In September of 2009, EPA approved the 2009 revisions to the AWQS and the December 2008 State of Alaska Toxics Manual which lists numerical limits. Except for cadmium and mercury, where the chronic cadmium standard changed from 9.3 µg/L in the SSWQC to 8.8 µg/L in the AWQS and the chronic mercury standard which changed from 0.025 µg/L in the SSWQC to 0.94 µg/L in the AWQS, all other dissolved metals criteria are the same in the two standards.

1.1.2 Environmental Background

The Asplund WPCF discharges off Point Woronzof into the receiving waters of Knik Arm in Upper Cook Inlet, Alaska. Cook Inlet is a major tidal estuary that is approximately 333 kilometers (km; 180 nautical miles) long and 93 - 148 km (50 - 80 nautical miles) wide at its lower end with a large assimilative capacity and over 16,000 square km of surface area. Bathymetry indicates the Inlet is deep, generally 36.6 m (20 fathoms) north of the Forelands and about 164.6 m (90 fathoms) at the mouth (refer to Figure 1). Numerous rivers, including the major Knik, Matanuska, and Susitna River drainages, discharge into the Inlet. A detailed map of the Point Woronzof region indicates deep water (9.1 - 51.8 m) extending well past Anchorage up the Knik Arm (Figure 2).

Cook Inlet is a unique estuary, with perhaps the closest parallel being the Bay of Fundy between New Brunswick and Nova Scotia, Canada. The occurrence of tidal bores at the head, currents of 4 - 6 knots, suspended loads of up to 2500 mg/L, large temperature extremes, and moving pancake ice of up to one meter (m) thick make Cook Inlet unique. The high tidal ranges result from the geometry of the Inlet which has a natural resonance period close to the semi-diurnal tidal period. The resulting large tidal fluctuations and fast currents cause complete vertical mixing of the Inlet waters including any discharges into those waters. Another important factor for the Point Woronzof discharge is the large volume of saline water that enters Cook Inlet that is completely vertically mixed with the riverine inputs by tidal turbulence. This allows the water body to be very effective in wastewater dilution and assimilation.

The particle size distributions of the natural suspended sediments near Point Woronzof show that very large particles are suspended by the current-generated turbulence, with 50 percent of the load being in the size range of 65 - 250 microns. The settling of large particles is seen at slack tide, but due to the shifting currents, never settle completely. Settling rate tests of the suspended material show that 93% of the solids in an ambient water sample settle in twenty minutes.

Previous work has indicated that due to the extremely swift currents, no seabed accumulation of suspended sediments, either natural or from the discharge, occurs in the vicinity of the outfall. In this location, the bottom is strictly coarse gravel and cobble because of these currents. Areas of deposition do exist however, such as to the east of Point Woronzof, where mudflats and beaches are found, and to the southwest of the Point. The area between Fire Island and the mainland is hard-packed sand with no deposition of silt or finer materials as a result of the high current

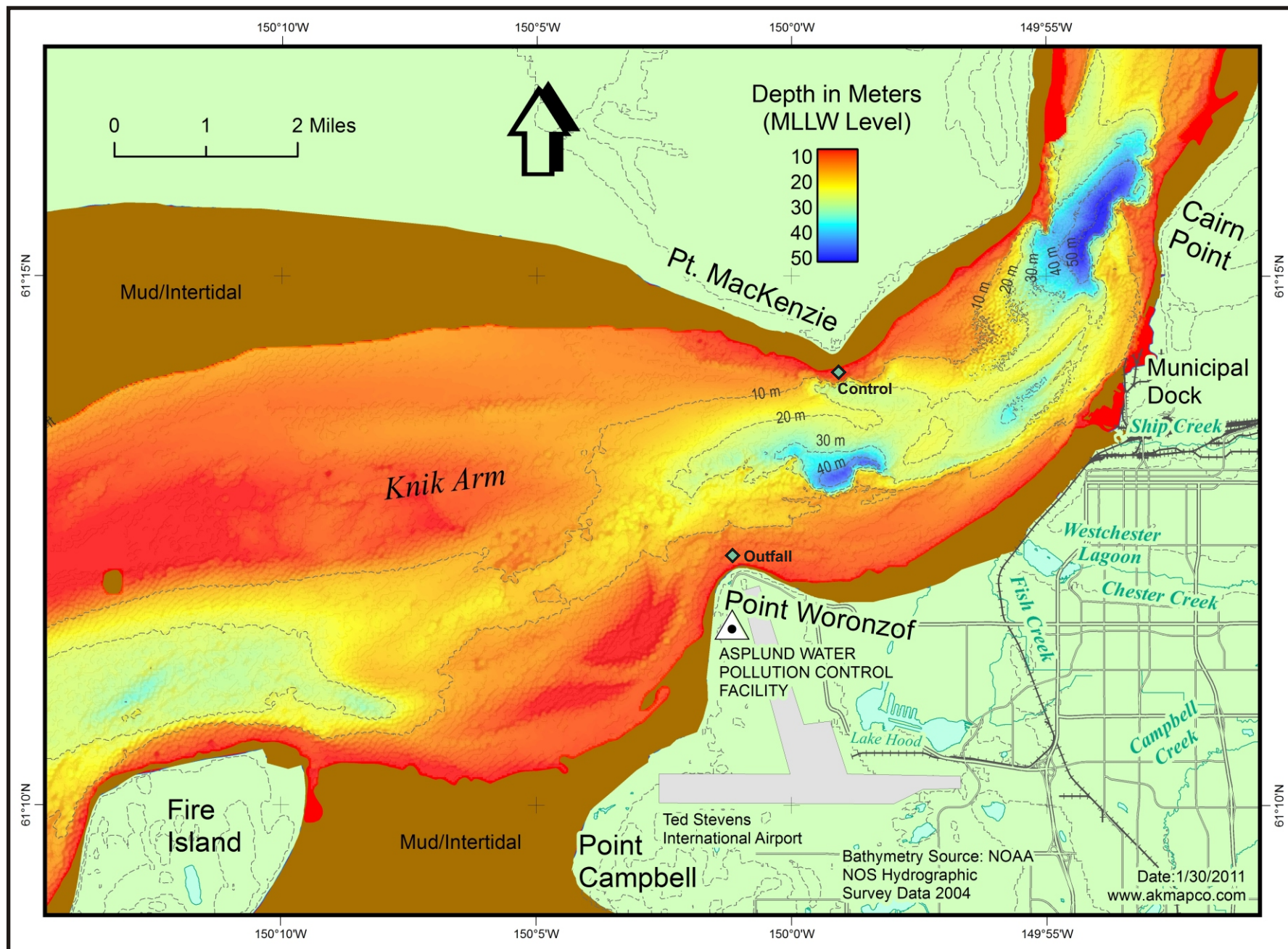


Figure 2. Asplund WPCF Outfall and Control Station Locations.

energy. Of course, any suspended solids in these materials of effluent origin would actually dilute the much larger natural load in the receiving water (400 - 2,500 mg/L versus approximately 60 mg/L effluent). Prior Asplund monitoring studies have also shown that essentially no benthic biota are found on the scoured cobble/gravel bottom or on the rock beaches in Knik Arm, at Point Woronzof, or at the control area. Similar sampling by these studies of soft-bottom beaches and tidal flats showed very sparse abundances and very low diversities (KLI 1979, 1987, and 1989). Benthic and intertidal marine fauna populations are limited by the naturally harsh physical environment of mud and glacial silt, high turbulence and bottom scouring, large tide and strong currents, and extreme ice conditions.

Current trajectories in the immediate vicinity of the outfall are of concern because of flow separation zones on either side of Point Woronzof. Previous work has indicated that, on a flood tide, a clockwise eddy sometimes exists east of Point Woronzof resulting in shoreward transport at certain stages of the flood tide. A flow separation also exists to the west of Point Woronzof during ebb flow; however, the effluent is not entrained shoreward in this area.

1.2 STUDY DESIGN

1.2.1 Monitoring Objectives

The monitoring program as described by NPDES Permit No. AK-002255-1 includes influent, effluent, and sludge monitoring at the Asplund WPCF; receiving water and sediment quality monitoring; biological and toxicological monitoring; and a toxics control program. The objectives of the overall monitoring program as outlined in the NPDES permit are to:

- Determine compliance with the NPDES permit
- Determine compliance with AWQS criteria
- Determine effectiveness of the industrial pretreatment program
- Aid in assessing the water quality at the discharge point
- Characterize toxic substances
- Monitor plant performance
- Determine compliance with the regulatory criteria of Section 301(h) of the CWA
- Determine the level of bacterial concentrations in nearshore waters
- Monitor for changes in sediment quality (organic enrichment, alteration of grain size distribution, and pollutant contamination) (note: not required or performed in 2014)
- Determine if pollutants from the discharge are accumulating in exposed biological organisms (note: not required or performed in 2014)
- Provide data for evaluating re-issuance of the NPDES permit

1.2.2 Program Description

The elements of the monitoring program for the Asplund WPCF are:

- Influent, Effluent, and Sludge Monitoring, including
 - In-plant sampling
 - Toxic pollutants and pesticides (including metals and cyanide)
 - Pretreatment monitoring
 - Whole effluent toxicity (WET) testing

- Receiving Water Quality Monitoring, including
 - Plume dispersion and water quality
 - Intertidal bacteria
- Biological and Sediment Monitoring, including
 - Sediment quality
 - Bioaccumulation

Table 1 provides an overview of the monitoring requirements as described by the permit. Detailed information regarding each program component is provided in Section 2.0, Methods.

1.2.3 Hypotheses

Hypotheses were formulated for the monitoring program as an unbiased approach in determining whether the Asplund WPCF was affecting the marine receiving water environment. The null (no effect) hypotheses tested each year of monitoring are as follows:

H₀1: Applicable State and Federal effluent and receiving water standards are met by the Asplund WPCF discharge.

H₀2: Water quality at the boundary of the zone of initial dilution (ZID) is not significantly changed with respect to nearfield or control stations.

1.3 CONTRACTOR

AWWU's designated contractor for the 2014 Asplund WPCF Monitoring Program was Kinetic Laboratories, Inc. (KLI) of Anchorage, Alaska.

Influent, effluent, and sludge analyses of aromatic hydrocarbons, pesticides, asbestos, volatile and semi-volatile priority pollutants, cyanide, and trace metals (total and dissolved) for the toxic pollutant and pretreatment monitoring were performed by ALS Environmental of Kelso, WA. WET testing was performed by Pacific EcoRisk of Fairfield, CA. In addition, AWWU's Asplund WPCF Laboratory performed the monthly in-plant influent, effluent, and sludge analyses as part of its self-monitoring program and contracted the Part 503 sludge analyses to Analytica Group, LLC of Anchorage, AK.

KLI also performed the receiving water sampling and analyses for turbidity and TRC. Analytical support for the receiving water sampling included: Eurofins Calscience, Inc. of Garden Grove, CA for trace metals; ALS Environmental for aromatic hydrocarbons and cyanide; Analytica Group, LLC for color analysis; AWWU's Asplund WPCF Laboratory for bacteriology and TSS; and TDI-Brooks International, Inc./B&B Laboratories, Inc. College Station, TX for polycyclic aromatic hydrocarbon (PAH) analyses.

1.4 PERIOD OF REPORT

This report documents results of the monitoring program from 1 January through 31 December 2014 under the current NPDES permit.

Table 1. Overall Monitoring Requirements.

Parameter	Frequency	Sample Type	Remarks
In-Plant Monitoring	See Table 2	See Table 2	See Table 2 - includes flow, TRC, DO, BOD ₅ , TSS, temperature, pH, fecal coliform, total ammonia as nitrogen, enterococci bacteria, and oil and grease
Toxic Pollutants and Pesticides (including Metals and Cyanide)	2/year ^a	influent, 24-hr composite effluent, 24-hr composite sludge, 24-hr composite	See Table 2
Pretreatment Program	2/year ^{a,b}	influent, three 24-hr composite effluent, three 24-hr composite sludge, 24-hr composite	Includes metals and cyanide plus percent solids for sludge
Whole Effluent Toxicity (WET) Testing	4/year ^c	effluent, 24-hr composite	See Table 2
Receiving Water Quality	1/year ^d	receiving water, grab	See Table 5
Intertidal Bacteria	1/year ^e	intertidal receiving water, grab	Fecal coliform sampling at 8 intertidal stations
Sediment	Once during the fourth year of the permit ^e	grab samples of surficial (0-2 cm) sediment collected at intertidal and subtidal stations ^f	Includes total volatile solids (TVS), toxic pollutants and pesticides (including metals and cyanide), and sediment grain size distribution
Bioaccumulation	Once during the fourth year of the permit	grab samples of intertidal macroalgae (<i>Vaucheria</i> spp.) Note: Macroalgae was not available during 2003 or 2004. Therefore, in consultation with EPA and AWWU, pacific cod (<i>Gasdus macrocephalus</i>) were collected and analyzed for this permit component in October 2004.	Includes toxic pollutants and pesticides (including metals and cyanide)

^a Sampling will be conducted twice per year: once in summer dry conditions and once in summer wet conditions.

^b One day of the three consecutive days of sampling will also serve as part of the Toxic Pollutant and Pesticides (metals and cyanide) sampling performed twice each year.

^c WET testing will be performed on a quarterly basis.

^d Sampling will be conducted once per year in summer dry conditions.

^e Sampling will be conducted in conjunction with the receiving water sampling.

^f Sampling will be performed at Intertidal Stations 1, 2, and Control (IT-1, IT-2, and IT-C); a subtidal station located at the ZID boundary; and a subtidal control station near Point MacKenzie (in a similar water depth as the ZID boundary).

2.0 METHODS

2.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

Influent, effluent, and sludge monitoring requirements as specified by the NPDES permit are outlined in Table 2. AWWU performed routine daily, weekly, and monthly sampling of conventional pollutant parameters, biannual sampling of enterococci bacteria, and daily measurements of flow rate. KLI performed the less-frequently monitored parameters of oil and grease, toxic pollutants and pesticides (including metals and cyanide), and WET testing.

- ✓ determine compliance with the NPDES permit and State of Alaska water quality criteria
- ✓ determine effectiveness of the industrial pre-treatment program
- ✓ aid in assessing the water quality at the discharge point
- ✓ characterize toxic substances
- ✓ help monitor plant performance
- ✓ determine compliance with the regulatory criteria of Section 301(h) of the CWA
- ✓ provide data for evaluating re-issuance of this permit

2.1.1 In-Plant Monitoring

In-plant influent, effluent, and sludge sampling was performed by AWWU personnel as described in Table 2 and in a separate monitoring program plan prepared by AWWU (AWWU, 2000). Samples were obtained following the schedule required by the permit. Influent was sampled at a representative location in the influent headworks, upstream from any recycle streams. Effluent was sampled at a well-mixed point downstream from the chlorination input point in the final effluent line with pumping of the sample back to the plant so that effluent samples were representative of actual chlorine contact time at the point of discharge. Composite sludge samples were obtained from the sludge feed screw auger downstream of the addition of primary scum and scum concentrator. Influent and effluent grab samples were obtained for pH and temperature, and effluent grab samples were obtained for total residual chlorine (TRC), dissolved oxygen (DO), and fecal coliform. Composite influent and effluent samples were obtained for the analysis of biochemical oxygen demand (BOD₅), total suspended solids (TSS), and total ammonia as nitrogen (effluent only).

2.1.2 Toxic Pollutant and Pesticide Monitoring

As outlined in the permit, toxic pollutant and pesticide sampling was conducted twice during 2014, once during June (summer-dry) and once during August (summer-wet). Samples were collected as required by the permit and either analyzed by AWWU laboratory personnel or provided to KLI for shipment to the appropriate analytical laboratory. Influent and effluent were sampled as discrete grabs or by 24-hour (hr) flow-proportional methodology (depending on the analysis method). Influent was sampled at a representative location in the influent headworks upstream from any recycle streams, and effluent was sampled at a well-mixed point downstream from the chlorination injection point in the final effluent line. Influent and effluent 24-hr flow-proportional sampling was performed with Teledyne ISCO Model 5800 Refrigerated Autosamplers. Influent and effluent samples were chilled as required during composite sampling. Sludge samples, consisting of eight discrete grabs collected every three hrs over a 24-hr period, were obtained from the sludge feed screw auger, chilled, and composited prior to analysis.

Influent and effluent composite samples included pesticides, semi-volatile organics, metals, asbestos, and cyanide. Influent and effluent grab samples included volatile organic analyses and total hydrocarbons as oil and grease. Volatile organics grab samples were collected every three hrs during the 24-hr sampling period and composited at the laboratory prior to analysis.

Table 2. In-Plant Influent, Effluent, and Sludge Monitoring Requirements.

Parameter	Sample Point ^a	Sample Frequency	Sample Type
Flow ^b	effluent	continuous	continuous
Total Residual Chlorine (TRC) ^b	effluent	continuous <u>or</u> every 2-4 hrs	grab
Dissolved Oxygen (DO) ^b	effluent	4/week	grab
Biochemical Oxygen Demand (BOD ₅) ^b	influent and effluent	4/week	24-hr composite
Total Suspended Solids (TSS) ^b	influent and effluent	4/week	24-hr composite
Temperature ^b	influent and effluent	4/week	grab
pH ^b	influent and effluent	4/week	grab
Fecal Coliform Bacteria ^b	effluent	3/week	grab
Total Ammonia as N ^b	effluent	1/month	24-hr composite
Enterococci Bacteria ^b	effluent	2/year ^d	grab
Oil and Grease ^c	effluent	2/year ^d	grab
Toxic Pollutants and Pesticides (including Metals and Cyanide) ^{c,e}	influent, effluent, and sludge	2/year ^d	24-hr composite
Whole Effluent Toxicity ^{c,f} (WET) Testing	effluent	4/year ^f	24-hr composite

^a When both influent and effluent samples are required, samples will be collected during the same 24-hr period.

^b AWWU performed this monitoring component.

^c KLI performed this monitoring component.

^d Twice per year sampling: during summer, once in dry conditions and once in wet conditions.

^e As part of the pretreatment program sampling requirements, arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, silver, and zinc in influent, effluent, and sludge will be sampled, along with percent solids (in sludge only). In 2014, these metals were analyzed for and reported as both total recoverable metals and dissolved metals for influent and effluent and as total metals in mg/kg dry weight for sludge. Sampling will be as follows: Influent and effluent as three separate 24-hr composite samples taken on three consecutive days, one day of which coincides with the twice-yearly sampling (summer-dry and summer-wet conditions); and sludge as one composite of eight grabs/day when influent and effluent samples are being taken. In addition, the other five metals from the toxic pollutant list will be analyzed in the summer-wet/summer-dry samples: beryllium, molybdenum, antimony, thallium, and selenium.

^f WET requirements are summarized in the text (Section 2.1.4). Initial testing was a screening period performed during three quarters, during which three species were tested to determine the most sensitive species. Re-screening was performed each year during one quarter (different than the previous year) to determine the most sensitive species to use for continued testing. Accelerated testing requirements will be triggered if chronic toxicity is greater than 143 TUC (chronic toxicity units, TUC=100/NOEC).

At time of collection, all samples were appropriately labeled using pre-prepared, project-specific sample labels as described in Section 2.5. Sample collection and shipment was documented using project-specific chain of custody (COC) forms as described in Section 2.5.

Toxic pollutants as defined by the permit are those substances listed in 40 Code of Federal Regulations (CFR) 401.15 (Table 3). This list involves 65 categories of pollutants, including asbestos, aromatic hydrocarbons, pesticides, metals, and polychlorinated biphenyls (PCBs). Pesticides as defined in the permit are demeton, guthion, malathion, mirex, methoxychlor, and parathion as listed in 40 CFR 125.58. Other pesticides which were tested for are included on the toxic pollutants list (40 CFR 401.15). The methods that were used to analyze these constituents for the program and for which KLI was responsible, as well as those performed by AWWU, are provided in Table 3. Preservation and maximum holding time information for each of these methods is provided in Table 4. All samples were collected in the appropriate sample containers and preserved, if necessary, as described by the EPA or equivalent approved standard methodology. All sample containers were immediately placed on gel ice after sampling. Samples remained chilled as required during shipment to the analytical laboratory.

2.1.3 Pretreatment Monitoring

The pretreatment monitoring program as outlined in Table 1 and Table 2 was performed by AWWU water quality laboratory staff. This monitoring was performed twice in 2014 in conjunction with the summer-dry and summer-wet sampling. As part of the pretreatment program sampling requirements, arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, silver, and zinc in influent, effluent, and sludge were sampled, along with percent solids (in sludge only). Although not required by the permit, the pretreatment sampling also included the metals: antimony, beryllium, molybdenum, selenium, and thallium. These samples were analyzed by ALS as total recoverable metals and dissolved metals for influent and effluent and as total recoverable metals in dry weight for sludge. Sampling was conducted as follows: Influent and effluent as three separate 24-hr composite samples taken on three consecutive days, one day of which coincided with each of the twice-yearly toxic pollutant and pesticide sampling efforts (summer-dry and summer-wet). The sludge sampling consisted of a single composite of eight grabs/day when influent and effluent composite samples were being taken. A detailed study plan describing this monitoring was provided previously (AWWU, 2000).

2.1.4 Whole Effluent Toxicity Testing

As outlined in the permit, WET testing was performed on a quarterly basis using 24-hr flow-composited effluent samples. Final effluent was sampled by discrete flow-proportional samplers at a well-mixed point downstream from the chlorination injection point. Effluent samples were collected in appropriate pre-cleaned sample containers as described in the bioassay method, chilled, and shipped immediately to the toxicity laboratory for testing. Samples were appropriately labeled at the time of collection using pre-prepared, project-specific sample labels as described in Section 2.5. Sample collection and shipment were documented using project-specific COC forms. Sample containers were immediately placed on gel ice after sampling and remained chilled during shipment to the toxicity laboratory.

Table 3. Methods^a for the Analysis of Toxic Pollutants and Pesticides for Influent, Effluent, and Sludge Monitoring.

Volatile Organic Compounds	Semi-Volatile Organic Compounds	Pesticides and PCBs	Inorganic Compounds
EPA 624 (Inf/Eff) SW 8260C (Sludge) Benzene Ethylbenzene Toluene Xylenes ^b	EPA 625 (Inf/Eff) SW 8270D (Sludge) Acenaphthene Benzidine Chloralkyl ethers Chlorinated ethanes Chlorinated naphthalenes Chlorinated phenols 2-chlorophenol DDT & metabolites Dichlorobenzenes Dichlorobenzidine 2,4-dichlorophenol 2,4-dimethylphenol Dinitrotoluene Diphenylhydrazine Fluoranthene Haloethers Heptachlor & metabolites Hexachlorobutadiene Hexachlorocyclopentadiene Hexachloroethane Isophorone Naphthalene Nitrobenzene Nitrophenols Nitrosamines Polycyclic aromatic hydrocarbons (PAHs) Pentachlorophenol Phenol Phthalate esters	SW 8141A (Inf/Eff) SW 8141B (Sludge) Demeton Malathion Parathion Guthion ^b	EPA 100.1/EPA 100.2 (Inf/Eff) EPA 600 (Sludge) Asbestos
EPA 624 (Inf/Eff) SW 8260C (Sludge) Acrolein ^b Acrylonitrile ^b Benzene Carbon tetrachloride Chloralkyl ethers Chloroform Chlorinated benzenes Chlorinated ethanes 1,2-dichloroethane Dichloroethylenes Dichloropropane Dichloropropene 1,1,1-trichloroethane Ethylbenzene Halomethanes Methylene chloride Bromoform Dichlorobromomethane Toluene Tetrachloroethylene Trichloroethylene Vinyl chloride	SW 8290 (Inf/Eff/Sludge) 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)	SW 8081B and SW 8082A (Inf/Eff/Sludge) Aldrin/Dieldrin Chlordane (technical Mixture & metabolites) DDT & metabolites Endosulfan & metabolites Endrin & metabolites Heptachlor metabolites Hexachlorocyclohexane Polychlorinated biphenyls (PCBs) Toxaphene Mirex ^b Methoxychlor ^b	EPA 200.8 (Inf/Eff) EPA 6020A or EPA 6010B (Sludge) Antimony Arsenic Beryllium Cadmium Chromium Copper Lead Molybdenum Nickel Silver Selenium Thallium Zinc EPA 1631E(Inf/Eff) SW7471B (Sludge) Mercury SM 4500-CN, E (Inf/Eff) EPA 9012B Mod (Sludge) Cyanide

Inf Influent

Eff Effluent

^a "EPA" refers to *Methods for Chemical Analysis of Water and Wastes*, 1983, EPA-600/4-79-020 or 40 CFR 136; "SM" refers to *Standard Methods for the Examination of Water and Wastewater*, 20th Ed., 1998; "SW" refers to SW 846, *Test Methods for Evaluating Solid Waste*. 3rd Ed., 1986.

^b Included with expanded method analyte list.

Table 4. Preservation and Analytical Procedures for Influent, Effluent, and Sludge.

Parameter	Sample Type	Preservation	Maximum Holding Time	Method ^a
Temperature	Inf/Eff	None required	Analyze immediately	SM 2550B
pH	Inf/Eff	None required	Analyze immediately	SM 4500-H ⁺ B
BOD ₅	Inf/Eff	Cool, ≤6°C	48 hours	SM 5210B
Total Residual Chlorine	Eff	None required	Analyze immediately	Hach 8167 (EPA 4500-Cl, G)
DO Electrode	Eff	None required	Analyze immediately	SM 4500-O G
Suspended Solids	Inf/Eff	Cool, ≤6°C	7 days	SM 2540G
Total Solids	Sludge	Cool, ≤6°C	7 days	EPA 160.3
Enterococci	Inf/Eff	Cool, ≤6°C, Na ₂ S ₂ O ₃ in effluent	8 hours total, 6 hours receipt by laboratory	SM 9230C
Asbestos	Inf/Eff	Cool, ≤6°C, dark	Filter within 48 hours of receipt at lab	EPA 100.1/100.2
	Sludge	Cool, ≤6°C	28 days	EPA 600
Fecal Coliform Bacteria	Eff	Cool, ≤6°C 0.0008% Na ₂ S ₂ O ₃	8 hours total, 6 hours receipt by laboratory	SM 9221E
Total Ammonia as N	Eff	Cool, ≤6°C, H ₂ SO ₄ to pH <2	28 days	Hach 8038 (EPA 4500-NH ₃ ,C)
Total Hydrocarbons as Oil and Grease	Inf/Eff	Cool, ≤6°C, dark HCl to pH <2	28 days	EPA 1664 HEM ^b
Volatile Organics	Inf/Eff	Cool, ≤6°C, dark, HCl to pH <2 L-Ascorbic Acid in effluent	14 days	EPA 624
	Sludge	Cool, ≤6°C	14 days	SW 8260C
Dioxins	Inf/Eff	Cool, ≤6°C	30 days until extraction/45 days after extraction	SW 8290
	Sludge	Cool, ≤6°C	30 days until extraction/45 days after extraction	SW 8290
Semi-Volatile Organics	Inf/Eff	Cool, ≤6°C, dark L-Ascorbic Acid in effluent	7 days until extraction/40 days after extraction	EPA 625
	Sludge	Cool, ≤6°C	14 days until extraction/40 days after extraction	SW 8270D
Pesticides & PCBs	Inf/Eff	Cool, ≤6°C, L-Ascorbic Acid in effluent	7 days until extraction/40 days after extraction	SW 8141A SW 8081B, SW 8082A
	Sludge	Cool, ≤6°C	14 days until extraction/40 days after extraction	SW 8141B SW 8081B, SW 8082A

Table 4. Preservation and Analytical Procedures for Influent, Effluent, and Sludge.
(continued)

Parameter	Sample Type	Preservation	Maximum Holding Time	Method ^a
Cyanide (total)	Inf/Eff	Cool, ≤6°C, NaOH to pH>12, 0.6 g L-Ascorbic Acid in effluent	14 days	SM 4500 CN, E
	Sludge	Cool, ≤6°C	14 days	EPA 9012 B Mod
Antimony	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A/6010 B
Arsenic	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A/6010 B
Beryllium	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A/6010 B
Cadmium	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A/6010 B
Chromium	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A/6010 B
Copper	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A/6010 B
Lead	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A/6010 B
Mercury	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	28 days	EPA 1631 E
	Sludge	Cool, ≤6°C	28 days	SW 7471A/B
Molybdenum	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A/6010 B
Nickel	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A/6010 B
Selenium	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A/6010 B
Silver	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A/6010 B
Thallium	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A/6010B
Zinc	Inf/Eff	Cool, ≤6°C, HNO ₃ to pH<2	6 months	EPA 200.8
	Sludge	Cool, ≤6°C	6 months	EPA 6020A/6010 B

^a Unless noted, "EPA" refers to *Methods for Chemical Analysis of Water and Wastes*, 1983, EPA-600/4-79-020 or 40 CFR 136; "SM" refers to *Standard Methods for the Examination of Water and Wastewater*, 20th Ed., 1998. "SW" refers to SW 846, *Test Methods for Evaluating Solid Waste*. 3rd Ed., 1986.

^b EPA, 1999a. Method 1664, Rev. A; Document No. EPA-821-R-98-002.

Initial WET testing was performed as a screening period over the course of three quarters during each of which three toxicity tests were performed: one vertebrate and two invertebrate species. These screening tests were performed during 2000 and 2001. Screening included the vertebrate *Atherinops affinis* (topsmelt) for survival and growth; an invertebrate bivalve species *Mytilus* spp. (mussel) for survival and growth; and an invertebrate echinoderm species *Strongylocentrotus purpuratus* (purple urchin) for fertilization. Once the initial screening period was completed, the single most sensitive species (bivalve) was used for subsequent toxicity testing until the next three-species screening was performed. As required by the permit, three-species screening must be performed each year during one quarter (different than the previous year) to determine the most sensitive species to use for continued testing. Re-screening that was performed in 2002 and 2003 found bivalves to be the most sensitive species. Three-species re-screening that was performed from 2004 through 2014 found the purple sea urchin to be the most sensitive species.

Accelerated testing requirements will be triggered if chronic toxicity is greater than 143 TUC (chronic toxicity units, $TUC = 100 / \text{No Observed Effect Concentration [NOEC]}$). Accelerated testing will include the implementation of the initial investigation Toxicity Reduction Evaluation (TRE) workplan along with at least one additional toxicity test. If the investigation indicates the source of toxicity (e.g., a plant upset), and no toxicity greater than 143 TUC is observed in this additional test, the normal schedule of testing is re-instated. If toxicity greater than 143 TUC is observed in the additional test, then accelerated testing will continue with six more tests performed on a biweekly basis over a 12-week period. Testing will commence within two weeks of receipt of the sample results indicating excess chronic toxicity. If no toxicity greater than 143 TUC is observed in these additional tests, then the normal schedule of testing is re-instated. If toxicity greater than 143 TUC is observed in any of the six tests, then a TRE will be initiated within 15 days of receipt of the sample results of the exceedance. A Toxicity Identification Evaluation (TIE) may also be initiated as part of the overall TRE process, and if this is initiated during the accelerated testing period, the accelerated testing may be terminated or used as necessary in performing the TIE.

Toxicity testing was performed as described in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms* (EPA, 1988) and the *West Coast Marine Methods Manual*, First Edition (EPA, 1995) as required by the permit. The presence of chronic toxicity was estimated as described by these references. Toxicity testing included the testing of a series of five dilutions and a control, including the predicted concentration of the effluent at the edge of the ZID (0.70%) as well as two dilutions above and two dilutions below the ZID concentration. Reference toxicants were tested concurrently with the effluent testing using the same procedures. If effluent tests did not meet all acceptability criteria as specified in the referenced methods, then the effluent was re-sampled and re-tested as soon as possible. Control and dilution water was natural filtered seawater as called for by the referenced methods. If dilution water was different from culture water, a second control using culture water was run.

As part of WET testing, an initial investigation TRE plan was prepared and submitted to EPA under separate cover (Kinnetic Laboratories, Inc., 2000b). This plan describes events that will occur should chronic toxicity be detected. As required by the permit and the manual *Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants* (EPA, 1999b), a preliminary toxicity evaluation will be initiated within 15 days of the receipt of sample results if chronic toxicity is detected above the toxicity trigger level. A more detailed TRE workplan will

subsequently be developed to more fully investigate and identify the cause of the toxicity, identify and provide a schedule of the actions that AWWU will use to mitigate the impact of the discharge, and to prevent the recurrence of the toxicity. As noted above, the TIE may be initiated as part of the overall TRE process during the accelerated testing schedule.

2.1.5 Part 503 Sludge Monitoring

Operations at the Asplund WPCF include a sewage sludge incinerator (SSI) that is subject to regulation under 40 CFR Part 503 - Standards for the Use or Disposal of Sewage Sludge. The current NPDES permit requires sludge monitoring twice per year, once during summer-dry conditions and once during summer-wet conditions as noted earlier. There are no Part 503 monitoring requirements included in the reissued NPDES permit because EPA Region 10's current policy is to remove these requirements from NPDES permits with the intention of writing "sludge only" permits in the future. However, the Part 503 regulations are "self-implementing" in that the facility is required to meet the sewage sludge incinerator (SSI) monitoring requirements in the regulation whether they are specifically included in a sludge only permit or not. Therefore, monitoring at the Asplund WPCF includes Part 503 monitoring of sludge. Monitoring frequencies required by 40 CFR Part 503 for incineration are once per 60 days for arsenic, cadmium, chromium, lead, and nickel. Frequency required for mercury is at least once per year. Frequency for beryllium is not specified. AWWU has chosen to also test for mercury and beryllium once per 60 days, more frequently than required, so as to be consistent with the testing frequency for the other metals. Allowable limits are site-specific and were calculated per Part 503 regulation in 2014 by ERM Alaska, Inc. based on 2012 data. While methods for this monitoring component have been described elsewhere (AWWU, 2000) and results of the monitoring have been provided under separate reporting requirements to EPA, the data are also included in this report.

2.2 RECEIVING WATER QUALITY MONITORING

2.2.1 Water Quality Sampling

As required by the permit, water quality must be monitored annually during the summer in dry weather conditions (Table 1). Sampling was performed at non-fixed stations during consecutive ebb and flood tides at the outfall station and a single flood tide at the control station. Station locations were determined by following the track of drogues released above the diffuser at the outfall station and at the control station located north across Knik Arm from Point Woronzof, directly off Point MacKenzie in a similar water depth to the outfall. Three drogue tracks on each tide were performed at each location. Four stations were sampled on each drogue track released at the outfall as follows:

- | |
|--|
| <ul style="list-style-type: none">✓ determine compliance with the NPDES permit and State of Alaska water quality criteria✓ aid in assessing the water quality at the discharge point✓ determine compliance with the regulatory criteria of Section 301(h) of the CWA✓ determine the level of bacterial concentrations in nearshore waters✓ provide data for evaluation of permit re-issuance |
|--|

- directly above the diffuser
- as close to the ZID boundary as practicable
- at least one nearfield station along the drogue's path
- in the shallow subtidal area before the drogue grounds or along the drogue's path at a far-field location.

As noted in the permit, the ZID is defined as the water column above the area delineated by the sector of a circle with the center located 245 meters (m) offshore over the outfall diffuser, 30 m shoreward of the diffuser, 650 m in radius, and with a 220° angle (Figure 3).

The plume location was determined by following a holey-sock current drogue (Figure 4). The drogue consisted of a six-foot cylindrical nylon tube ballasted at the bottom with a two-pound weight and lead line and attached at the top with a bridle to a spherical float. This float was attached to the tracking spar via a connecting line. These cylindrical or spherical designs that enclose a parcel of water have been found to more accurately follow the ambient current patterns than other drogue designs such as the window shade design (Sombardier and Niiler, 1994).

Sampling was performed by positioning the vessel over the diffuser (or control station) for the first sampling station of the drogue track. The drogue was released at the same time and followed until navigation information indicated that the ZID had been reached, at approximately 650 m from the outfall, at which time the ZID boundary station was immediately sampled. The third and fourth stations along each drogue track were sampled as the drogue traveled through the channel in Knik Arm or as it slowed in shallow water prior to grounding. Navigation was accomplished using a differential global positioning system (DGPS) with an accuracy of ± 5 m.

Samples were collected for the parameters outlined in Table 5. The surface waters of all stations were sampled for fecal coliform, color, turbidity, and TRC. Surface samples were collected by grabbing directly into the appropriate sample bottles at sample depth (15 - 30 centimeters [cm]). Mid- and bottom depth turbidity samples were collected at all stations using Niskin[®] bottles. Mid- and bottom depths were determined at each station using the survey vessel's fathometer. Samples were collected as simultaneously as possible at all three target depths. Hydrographic profiles of temperature, salinity, DO, and pH were collected at all stations using a Seabird SEACAT[®] SBE-19 CTD (conductivity, temperature, and depth) recorder. This instrument was also equipped with a DO, pH, and optical backscatter (turbidity) sensors to allow profiles of these parameters to be recorded. Samples for the analysis of total and dissolved metals, TSS, polycyclic aromatic hydrocarbons (PAH), and total aromatic hydrocarbons (TAH) were collected from surface waters at the first three stations (diffuser, ZID boundary, and channel) at low tide along the first flood drogue track at both the outfall and control stations. These samples were collected as grab samples directly into the appropriate sample containers. A single replicate sample for each parameter or a single hydrographic profile was collected at each station except for quality control samples, which are described in Section 4.

Samples were analyzed following the methods provided in Table 6. Samples were appropriately labeled at the time of collection using pre-prepared, project-specific sample labels as described in Section 2.5 and prepared for shipment to the laboratory. Preservation and maximum holding time information for each of these methods is also provided in Table 6. All sample containers were immediately placed on gel ice after sampling. Samples remained chilled as required during shipment to the analytical laboratory.

2.2.2 Intertidal Bacterial Sampling

As part of the receiving water quality monitoring effort, intertidal sampling for fecal coliform bacteria was also performed at eight stations listed in Table 7 and depicted in Figure 3. Two

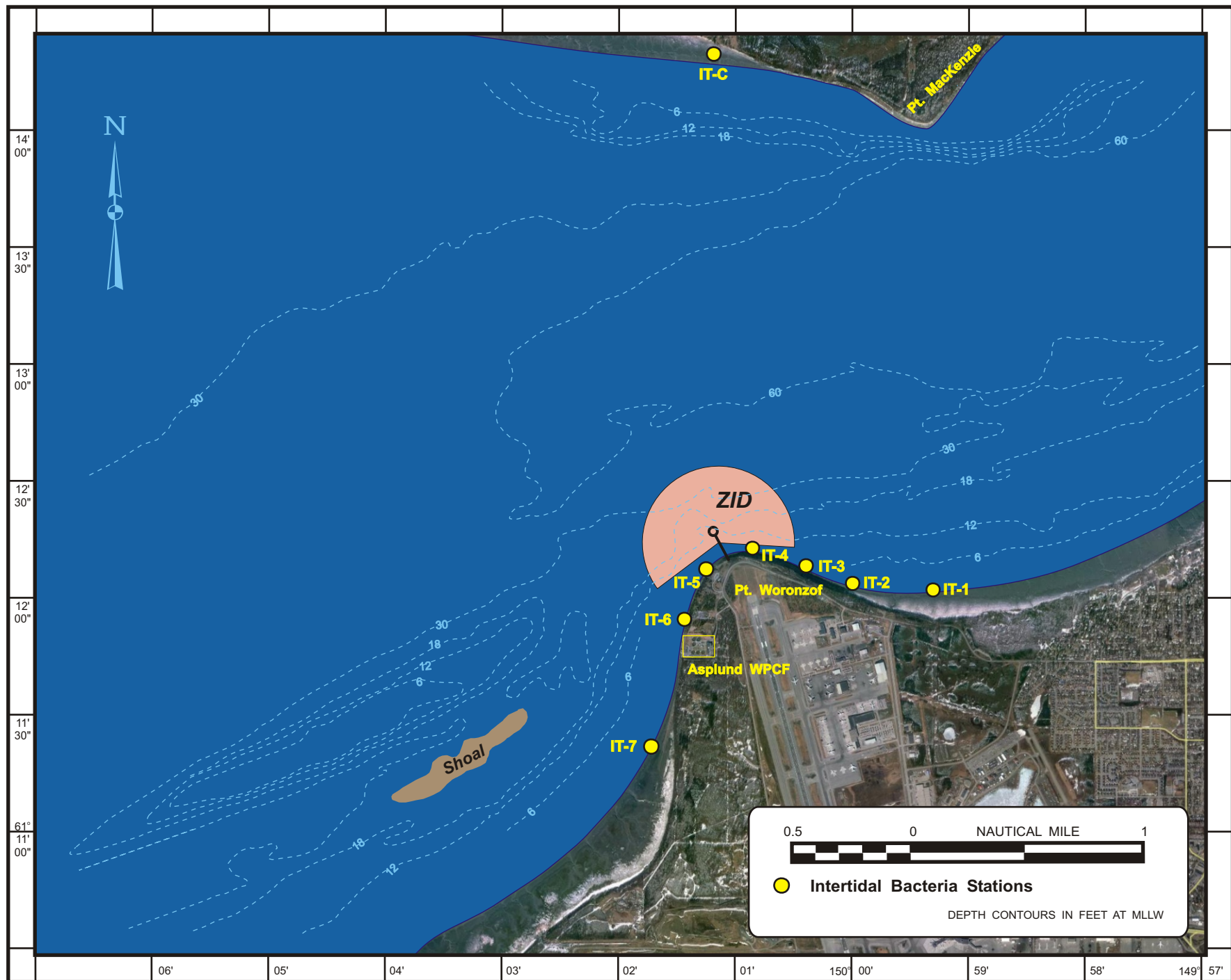


Figure 3. Asplund WPCF Outfall, ZID, and Locations of Intertidal Bacteriological Sampling.

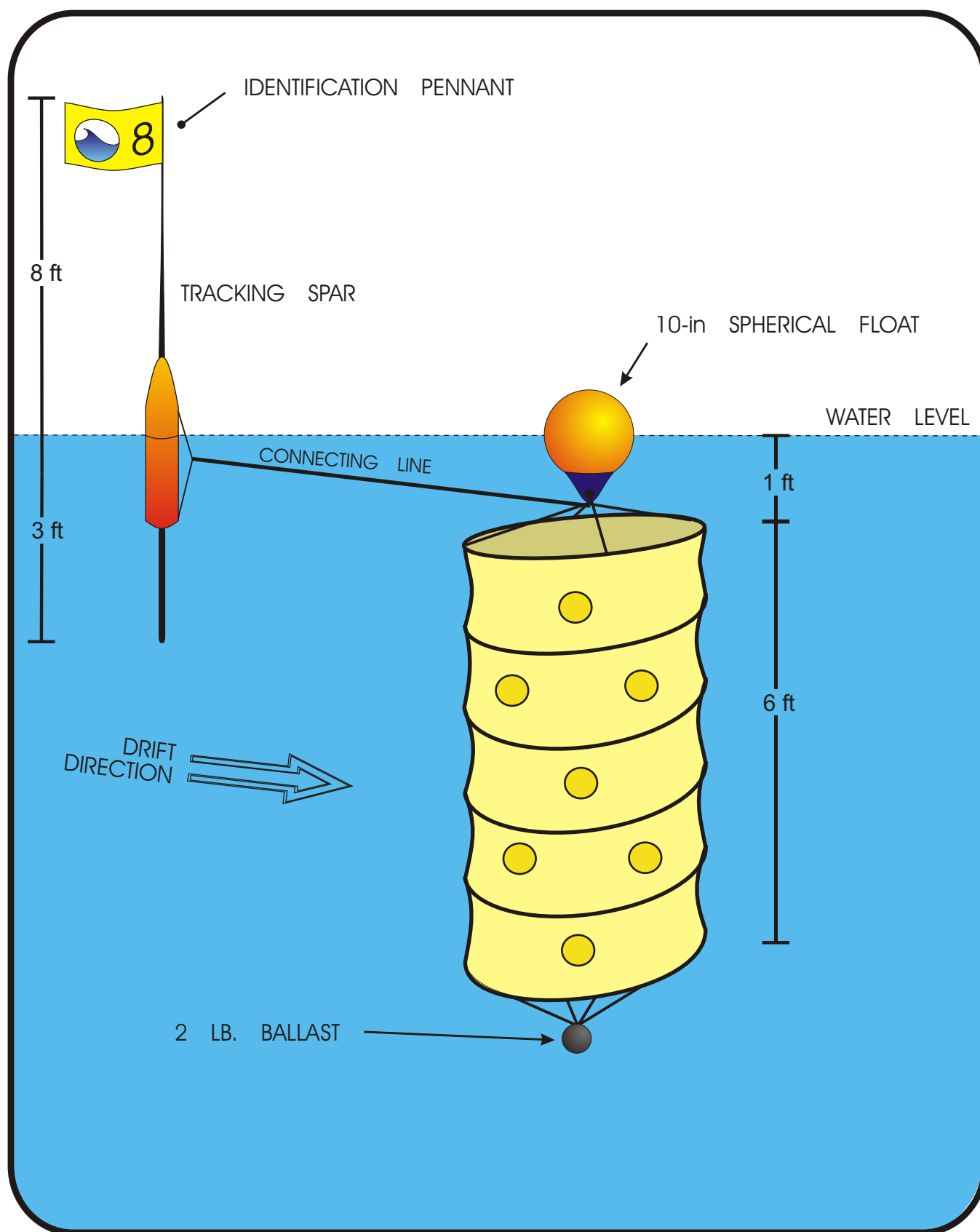


Figure 4. Holey-Sock Drogue, Flotation, and Marker Buoy.

Table 5. Receiving Water Quality Monitoring Requirements.

Parameter	Sampling Depth		
	Surface (above 0.5 m)	Surface, Mid-, and Bottom	Profile (1- to 3-m intervals)
Fecal Coliform	all stations ^a , within the 15-30 cm layer		
Color	all stations, within the 15-30 cm layer		
Total Residual Chlorine (TRC)			
Field Observations: presence or absence of floating solids, visible foam (other than trace), oil wastes, and/or sheen	all stations where surface samples are collected		
Total Aqueous Hydrocarbons (TAqH)	first three stations along the first flood drogue track at both the outfall and control locations		
Total Aromatic Hydrocarbons (TAH)			
Metals and Cyanide ^b			
Total Suspended Solids (TSS)			
Turbidity		all stations	
pH			all stations
Temperature			
Dissolved Oxygen (DO)			
Salinity			

^a Non-fixed stations were sampled following the track of drogues released at the diffuser (outfall station) or at a fixed station having the same depth due north across Knik Arm from Point Woronzof near Point MacKenzie (control station). Three drogue tracks were made during each of a consecutive flood and ebb tide at the outfall station. Stations included the following along each outfall drogue track: above the diffuser; as close to the ZID boundary as practicable; one near-field station in the channel of Knik Arm; and a far-field station along the drogue path or in the shallow subtidal area before the drogue grounds. Three drogue tracks were also made during a flood tide at the control station in conjunction with or as soon as practicable as the sampling at the outfall station.

^b Metals include arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc; these were analyzed and reported as both total recoverable and dissolved metals.

Table 6. Methods, Preservation, and Maximum Holding Times for the Analysis of Receiving Water Quality Samples.

Parameter	Method ^a	Preservation	Maximum Holding Time
Fecal Coliform	SM 9221E	Cool, ≤6°C, dark, (0.0008% Na ₂ S ₂ O ₃ in presence of chlorine)	8 hours (6 hours max transport, 2 hours once received by lab)
Color	SM 2120B	Cool, ≤6°C, dark	48 hours
Total Residual Chlorine (TRC)	SM 4500-Cl I	None	Analyze immediately
Turbidity	SM 2130B	Cool, ≤ 6°C, dark	48 hours
Total Aqueous Hydrocarbons (TAqH)	EPA 602 list plus xylenes, using method EPA 624	Cool, ≤6°C, HCl to pH<2, L-Ascorbic Acid in presence of chlorine	14 days
	EPA 610	Cool, ≤6°C, dark, L-Ascorbic Acid in presence of chlorine	7 days until extraction/ 40 days after extraction
Total Aromatic Hydrocarbons (TAH)	EPA 602 list, using method EPA 624	Cool, ≤6°C, HCl to pH<2 L-Ascorbic Acid in presence of chlorine	14 days
Metals (Total Recoverable and Dissolved ^b)	EPA Method 1640 EPA Method 1631E (Mercury)	Cool, ≤6°C, HNO ₃ to pH<2 (after filtration for dissolved)	180 days 90 days – Mercury
Cyanide	SM 4500-CN, E	Cool, ≤6°C NaOH to pH <12	14 days
Total Suspended Solids (TSS)	SM 2540D	Cool, ≤6°C	7 days
Dissolved Oxygen (DO)	SM 4500-O G (electrode)	None	<i>in situ</i>
pH	SM 4500-H ⁺ B	None	<i>in situ</i>
Temperature	SM 2550B ^c	None	<i>in situ</i>
Salinity	SM 2520B ^c	None	<i>in situ</i>

^a "EPA" refers to the EPA document *Methods for Chemical Analysis of Water and Wastes*, revised March 1983, Document No. EPA-600/4-79-020 or 40 CFR 136. "SM" refers to *Standard Methods for the Examination of Water and Wastewater*, 20th ed., 1998.

^b Dissolved metals were filtered before acidification.

^c Modified for *in situ* measurements collected with the CTD.

Table 7. Approximate Locations of Intertidal Bacteria Sampling Stations.

Station	Station Location Relative to Diffuser	Latitude (N)	Longitude (W)
IT-1	2000 m east	61° 12' 10"	149° 58' 55"
IT-2	1200 m east	61° 12' 11"	149° 59' 50"
IT-3	750 m east	61° 12' 15"	150° 00' 20"
IT-4	250 m east	61° 12' 19"	150° 00' 52"
IT-5	250 m southwest	61° 12' 15"	150° 01' 10"
IT-6	750 m southwest	61° 12' 02"	150° 01' 28"
IT-7	2000 m southwest	61° 11' 22"	150° 02' 02"
IT-C	Across Knik Arm, approximately 4 km due north from the diffuser	61° 14' 26"	150° 01' 09"

replicate water samples were collected from each station near high slack water when the water depths were between 1 to 3 feet (ft). Additional quality control samples were collected as described in Section 4.2. Surface samples were collected by grab sampling from 15 - 30 cm depths, directly into the appropriate container. Samples were analyzed using the same procedures described previously and in Table 6.

In addition to the required intertidal samples, two replicated fecal coliform samples were also collected once during the water quality monitoring effort from three area streams that empty into Knik Arm: Ship, Chester, and Fish Creeks. Grab samples were collected from the surface of each stream and were analyzed using the same procedures described previously and in Table 6.

At time of collection, all fecal coliform samples were appropriately labeled using pre-prepared, project-specific sample labels as described in Section 2.5. All samples were collected in the appropriate pre-cleaned certified sample containers, dechlorinated when necessary, and preserved as described by the method. Samples were placed on gel ice immediately after sampling and remained chilled during transport to the laboratory. Field notes, including navigational and sampling information, were recorded on project-specific field logs. As required by the permit, field observations taken at each station included the presence or absence of floating solids, visible foam in other than trace amounts, oily wastes, or sheen. Weather observations were also recorded. All field documentation was reviewed by the field leader at the completion of the survey for accuracy and completeness. Sample collection and shipment was documented using project-specific chain of custody forms as described in Section 2.5.

2.2.3 Vessel Support

The *NORTH FORTY*, a 26-ft KLI-owned survey vessel, was used for drogue tracking and water sampling in 2014. In addition, a 15-ft Zodiac[®] was used to retrieve grounded drogues and conduct intertidal bacteria sampling. The Zodiac[®] was also used to transport samples with short holding times (i.e., bacterial and turbidity samples) ashore during the sampling effort.

2.3 SEDIMENT AND BIOACCUMULATION MONITORING

As stipulated in the NPDES permit, sediment and bioaccumulation monitoring was to be performed during the fourth year after the effective date of the permit. Accordingly, the intertidal and subtidal sediment sampling was performed and reported in conjunction with the 2003 receiving water monitoring program and the bioaccumulation sampling was performed and reported in conjunction with the 2004 monitoring effort.

2.4 LABORATORY ANALYSIS

Laboratory analyses of all samples for this monitoring program followed preservation and analysis procedures described by EPA-accepted protocols as referenced in this document (Table 4 and Table 6). These procedures are fully described by the referenced documents and/or 40 CFR 136.

2.5 DOCUMENTATION PROCEDURES

All field and sampling data were recorded on appropriate pre-printed project-specific field data collection forms. Field data collection forms included drogue tracking forms, hydrographic field log forms, sample identification/COC forms, and sample labels. These forms were tailored to the monitoring program to facilitate accurate and complete documentation of field activities. The field task leader was responsible for review and approval of all field documentation. This was completed as soon as possible after sampling.

Hydrographic field logs included specific information such as station identification, sample identification numbers, navigational data, sampling or photographic observations, sampling depths, and collection date and time. Drogue tracking logs included station identification information along with navigational data to allow the track of each drogue to be later determined and plotted. Pre-printed labels included such information as station designation, analysis type, date and time of sample collection, sampling personnel, and a pre-assigned sample identification number to uniquely identify each sample. Field duplicate and field blank quality control (QC) samples were labeled as were regular environmental samples so as to be blind to the laboratory analysts that were preparing and conducting the analyses.

Sample identification and integrity was ensured by a rigidly-enforced COC program. COC forms documented specific information concerning the sample identification, handling, preservation, shipment, and custody of the samples.

Pertinent information from the sample label was transferred onto the COC, along with other information as required. COC forms were completed, signed by field personnel, and copied if needed. In some cases, where photocopying was not convenient or possible, two-part carbonless forms were used. The original of each COC form was packed with the samples in coolers for shipment to the laboratory. The field task leader retained a copy of each form for the field records and for tracking purposes should a shipment become lost or delayed. Upon receipt of the samples at the analytical laboratory, the laboratory sample custodian signed the samples in by checking all sample labels against the COC information and noting any discrepancies as well as sample condition (e.g., sample temperature, containers leaking or damaged during shipment). Internal sample tracking procedures at the laboratory were initiated immediately upon receipt of samples as described by each laboratory's standard operating procedures.

3.0 RESULTS

3.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

3.1.1 Monthly Discharge Monitoring Data

Results of AWWU's daily, weekly, and monthly sampling of influent and effluent for non-metals are presented as monthly summaries in Table 8. Averages are based on the 12-month period from January through December 2014.

The percent removal of BOD₅ and TSS as determined by subtracting the effluent concentration from the influent concentration divided by the influent concentration ($[(\text{Inf}-\text{Eff})/\text{Inf} \times 100]$) averaged 42.8% for BOD₅ and 77.3% for TSS in 2014. On a monthly average basis, BOD₅ removal ranged from 36.5 to 46.9%. These averages exceed minimum values required by CWA amendments (40 CFR Part 125.60), whereby dischargers with 301(h) variances are required to remove 30% of BOD₅ and 30% of the suspended solids on a monthly basis. The highest monthly average effluent BOD₅ was 173 mg/L, substantially less than the permit limitation of 240 mg/L. All BOD₅ values (daily, weekly, and monthly averages) reported for calendar year 2014 met permit limitations. Concentrations of TSS in the effluent were low and typical of those seen historically at the Asplund WPCF, with the highest monthly average effluent concentration of 65 mg/L compared to the permit limit of 170 mg/L. Weekly average and daily maximum TSS also met permit requirements for all sampling events in 2014. On a monthly average basis, removal of TSS ranged from 74.3 to 81.0% with all values meeting CWA requirements of 30% removal.

The highest geometric mean monthly fecal coliform count was 14 FC/100 mL, seen in April 2014. All months in 2014 met the permit limitation of 850 FC/100 mL, based on a geometric mean of at least five samples. Geometric means ranged from 2 to 14 FC/100 mL, well below the permit limitation. The criterion of not more than 10% of samples analyzed exceeding 2,600 FC/100 mL was met in 2014. In general, better plant performance trends in terms of more effective chlorine disinfection have resulted in lower fecal coliform bacteria concentrations in recent years.

The TRC daily maximum concentration did not exceed the permit-required limitation of 1.2 mg/L for the entire year, with a maximum daily value of 0.94 mg/L and a monthly maximum daily range of 0.62 to 0.94 mg/L. The monthly averages of TRC concentrations ranged from 0.36 to 0.59 mg/L, with an overall annual average of 0.46 mg/L. The permit requirement that effluent pH remain between 6.5 and 8.5 standard units was always met, exhibiting a daily minimum and maximum range of 6.79 to 7.36 pH units for the year. This indicates a very consistent level of treatment and close adherence to operational goals and procedures.

Although other parameters such as DO, temperature, and ammonia do not have permit limitations, ranges were typical of those seen historically. DO in the effluent exhibited monthly averages ranging from 1.2 to 3.6 mg/L, with a yearly average of 2.3 mg/L which was similar to that seen in 2012 and 2013 where the yearly averages were 2.6 and 2.4 mg/L, respectively. Temperature showed yearly averages of 13.4 °C and 12.9 °C in the influent and effluent, respectively. Monthly values for total ammonia in the effluent ranged from 21.2 to 28.8 mg/L, with a yearly average of 23.9 mg/L, similar to that seen historically. Average effluent flow for the year was 26.85 million gallons per day (mgd) which is very similar to the average flow rate seen over the past five years.

Table 8. Discharge Monitoring Data for Influent and Effluent Non-Metals.

Month	Average EFF Flow Rate (MGD)	Temperature Average (°C)		pH Minimum/ Maximum (pH) ^a		TRC Average (mg/L)		DO Average (mg/L)		BOD ₅ Average (mg/L)			Total Susp. Solids Average (mg/L)			Fecal Coliform Average (MPN/100 mL)		Total Ammonia One per month (mg/L)	
		INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	REM (%)	INF	EFF	REM (%)	INF	EFF	INF	EFF
01/14	28.13	12.0	11.2	7.27/7.63	6.85/7.36	NT	0.51	NT	3.0	259	151	41.7	225	55	75.6	NT	4	NT	21.7
02/14	26.24	11.6	10.6	7.33/7.68	6.98/7.28	NT	0.43	NT	2.4	266	169	36.5	248	60	75.8	NT	2	NT	24.0
03/14	25.57	11.5	10.6	7.38/7.66	7.02/7.24	NT	0.38	NT	2.0	281	167	40.6	253	65	74.3	NT	4	NT	26.7
04/14	29.00	11.1	10.3	7.39/7.78	7.08/7.30	NT	0.50	NT	2.0	264	152	42.4	243	60	75.3	NT	14	NT	23.4
05/14	27.75	12.4	11.9	7.45/7.73	7.14/7.31	NT	0.42	NT	2.8	266	150	43.6	265	60	77.4	NT	3	NT	21.2
06/14	27.74	14.0	13.5	7.33/7.68	6.98/7.27	NT	0.38	NT	2.2	280	158	43.6	278	62	77.7	NT	5	NT	23.2
07/14	27.24	15.3	15.2	7.00/7.58	6.83/7.32	NT	0.36	NT	1.2	309	167	46.0	305	58	81.0	NT	5	NT	22.4
08/14	27.06	15.5	15.9	7.27/7.58	6.86/7.17	NT	0.45	NT	1.7	294	165	43.9	276	59	78.6	NT	4	NT	23.4
09/14	28.46	15.3	15.5	7.21/7.49	6.90/7.15	NT	0.53	NT	3.6	254	135	46.9	260	53	79.6	NT	6	NT	21.6
10/14	26.14	15.0	14.3	7.32/7.57	6.88/7.23	NT	0.40	NT	2.1	275	156	43.3	264	61	76.9	NT	11	NT	26.4
11/14	24.94	14.0	13.4	7.34/7.68	6.93/7.30	NT	0.54	NT	2.1	296	173	41.6	261	56	78.5	NT	3	NT	24.5
12/14	23.94	13.2	12.6	7.23/7.55	6.79/7.22	NT	0.59	NT	2.2	273	153	44.0	244	56	77.0	NT	3	NT	28.8
Average	26.85	13.4	12.9	7.00/7.78	6.79/7.36	NT	0.46	NT	2.3	276	158	42.8	260	59	77.3	NT	5	NT	23.9

^a Monthly or Yearly (minimum/maximum)

INF Influent

EFF Effluent

NT Not tested (tested in effluent only)

REM Percent Removal

3.1.2 Toxic Pollutants and Pesticides Analyses

Toxic pollutant and pesticide monitoring for influent, effluent, and sludge was conducted on 11 - 12 June 2014 for summer-dry weather and 3 - 4 August 2014 for the summer-wet weather sampling. Sampling was performed over a 24-hr period by AWWU personnel.

Results of the toxic pollutant and pesticide analyses are provided in Table 9 (June 2014) and Table 10 (August 2014). For semi-volatile organic compounds (EPA Methods 625/8270D), volatile organic compounds (EPA Methods 624/8260C), and pesticides (EPA Methods 8081B, 8082A, and 8141A/B), only those pollutants that were detected in the influent, effluent, or sludge are listed. All other compounds were not detected above method detection limits (MDLs). Refer to Appendices A and B for laboratory reports and a complete listing of pollutants analyzed. Pollutants found in the influent were usually detected in the effluent and vice versa, and were also often present in the sludge. In general, pollutant concentrations were very low and many of the concentrations for the two sampling events were estimates that fell below the method reporting limits (MRLs) but above the MDL.

Percent removal values shown in these tables were computed from influent and effluent concentrations. Percent removal was only calculated for compounds where a concentration in the influent and effluent was reported at a level above the MRL. Compounds with estimated concentrations (denoted with a "J" qualifier) or those reported as not detected (ND) were not used for percent removal calculations. Where laboratory duplicate analyses were performed for a parameter, a percent removal is provided for each duplicate. For summed values, such as benzene, ethylbenzene, toluene, and xylenes (BETX), the MDL was used for ND values.

Percent removal calculations for some contaminants may not truly represent treatment plant efficiency due to several factors that influence removal rates. Most notable is the fact that influent and effluent autosamplers do not produce parallel samples over the same required 24-hr time interval due to the approximate 6-hr hydraulic residence time of wastewater flow through the treatment process prior to being discharged as final effluent. Also affecting percent removal calculation is the addition of more than 1 million gallons of fresh water from the city's drinking water supply and/or on-site well water to the treatment process. Additionally, thickened sludge from both the Girdwood and Eagle River wastewater treatment facilities (WWTFs) is processed at the Asplund WPCF, resulting in additional wastewater being added to the effluent stream, and incinerator scrubber and in-plant wash-down waters are added back into the treatment process which only impacts the effluent composite sample. Often the percent removal calculation is performed on data near the MRL. Due to these factors, calculation of negative pollutant removals is possible, in spite of all evidence supporting an efficient and effective treatment process indicated by very high removal efficiencies seen for TSS and BOD₅.

Types and concentrations of measured volatile and semi-volatile organic compounds were fairly consistent between the two sampling periods. Volatile compounds detected in both the influent and effluent during both sampling events included: 1,4-dichlorobenzene, 2-butanone, acetone, benzene, carbon disulfide, chloroform, ethylbenzene, m,p-xylenes, methylene chloride, o-xylene, tetrachloroethene, and toluene. Most of these compounds were estimated values as they were detected below their MRLs and therefore were qualified with a J.

Table 9. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge. Sampled 11 and 12 June 2014.

Pollutant	Influent^a (µg/L)	Effluent^{a,b} (µg/L)	Sludge^b (mg/kg)	Percent Removal
DISSOLVED METALS				
Antimony	0.543	0.571	NT	-5.2
Arsenic	2.0	2.5	NT	-25.0
Beryllium	ND (0.006)	ND (0.006)	NT	---
Cadmium	0.039	0.083	NT	-112.8
Chromium	1.09	0.91	NT	16.5
Copper	17.7	23.2	NT	-31.1
Lead	0.457	0.558	NT	-22.1
Mercury	0.0120	0.00611	NT	49.1
Molybdenum	2.62	4.81	NT	-83.6
Nickel	4.66	4.56	NT	2.1
Selenium	0.5 J	0.6 J	NT	---
Silver	0.084	0.082	NT	2.4
Thallium	0.007 J	ND (0.005)	NT	---
Zinc	28.6	54.2	NT	-89.5
TOTAL METALS				
Antimony	0.801	0.675 / 0.677	1.66 / 1.76	15.7 / 15.5
Arsenic	3.3	2.9 / 3.0	5.26 / 4.82	12.1 / 9.1
Beryllium	0.016 J	0.011 J / 0.008 J	0.067 / 0.062	--- / ---
Cadmium	0.290	0.187 / 0.186	1.12 / 1.17	35.5 / 35.9
Chromium	3.09	2.02 / 1.97	15.2 / 14.0	34.6 / 36.2
Copper	73.2	39.2 / 39.5	236 / 227	46.4 / 46.0
Lead	3.15	1.59 / 1.59	14.1 / 14.7	49.5 / 49.5
Mercury	0.134	0.0546	0.590	59.3
Molybdenum	3.63	5.34 / 5.13	5.27 / 4.89	-47.1 / -41.3
Nickel	7.10	5.40 / 5.52	14.3 / 12.6	23.9 / 22.3
Selenium	0.6 J	0.8 J / 0.8 J	2.27 / 2.15	--- / ---
Silver	0.604	0.296 / 0.278	3.09 / 3.55	51.0 / 54.0
Thallium	ND (0.005)	ND (0.005) / ND (0.005)	0.023 / 0.023	--- / ---
Zinc	181	94.7 / 96.4	661 / 631	47.7 / 46.7

Table 9. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge. Sampled 11 and 12 June 2014.

Pollutant	Influent^a (µg/L)	Effluent^{a,b} (µg/L)	Sludge^{a,b} (mg/kg)	Percent Removal
VOLATILE ORGANICS - detected substances only				
Acetone	180	230	ND (0.0093)	-27.8
Benzene	0.22 J	0.26 J	0.0028 J	---
Bromodichloromethane	0.10 J	0.20 J	ND (0.00051)	---
2-Butanone	27	51	1.500	-88.9
Carbon Disulfide	0.22 J	0.41 J	0.060	---
Chlorobenzene	ND (0.031)	0.040 J	ND (0.00021)	---
Chloroethane	ND (0.14)	0.41 J	ND (0.0024)	---
Chloroform	2.5	4.2	0.0011 J	-68.0
Chloromethane	ND (0.030)	0.80	ND (0.00058)	---
1,4-Dichlorobenzene	0.69	0.63	0.012 J	8.7
cis-1,2-Dichloroethene	0.17 J	0.14 J	ND (0.00039)	---
Ethylbenzene	4.7	0.46 J	0.011 J	---
2-Hexanone	ND (2.5)	ND (2.5)	0.640	---
Methylene Chloride	1.2 J	1.7 J	0.012 J	---
Styrene	ND (0.023)	0.050 J	0.00086 J	---
Tetrachloroethene	0.41 J	0.40 J	0.019	---
Toluene	20	7.5	0.210	62.5
Trichloroethene	0.090 J	0.070 J	ND (0.00048)	---
m,p-Xylenes	21	1.5	0.036	92.9
o-Xylene	7.5	0.73	0.014 J	90.3
SEMI-VOLATILE ORGANICS - detected substances only				
Anthracene	ND (0.34)	ND (0.36)	0.31 J	---
Benz(a)anthracene	ND (0.26)	ND (0.28)	0.53 J	---
Benzo(a)pyrene	ND (0.38)	ND (0.41)	0.44 J	---
Benzo(b)fluoranthene	ND (0.28)	ND (0.30)	0.63 J	---
Bis(2-ethylhexyl) Phthalate	8.0 J	8.8 J	21	---
Butyl Benzyl Phthalate	2.8 J	2.0 J	ND (0.31)	---
Chrysene	ND (0.41)	ND (0.44)	0.52 J	---
Diethyl Phthalate	2.9 J	3.0 J	ND (0.27)	---
Di-n-butyl Phthalate	0.51 J	0.91 J	0.84 J	---
Fluorene	ND (0.24)	ND (0.26)	0.32 J	---
Fluoranthene	0.59 J	0.54 J	2.2 J	---
Naphthalene	0.53 J	0.57 J	0.29 J	---
2-Nitrophenol	ND (0.36)	1.6 J	ND (0.27)	---

Table 9. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge. Sampled 11 and 12 June 2014.

Pollutant	Influent^a (µg/L)	Effluent^{a,b} (µg/L)	Sludge^{a,b} (mg/kg)	Percent Removal
N-Nitrosodi-n-propylamine	ND (0.53)	6.1 J	ND (0.36)	---
Phenanthrene	0.55 J	0.47 J	2.2 J	---
Phenol	24	21	ND (0.73)i	12.5
Pyrene	ND (0.48)	ND (0.52)	1.4 J	---
2,4,6-Trichlorophenol	ND (0.20)	0.61 J	ND (0.27)	---
HYDROCARBONS				
Oil & Grease (EPA 1664-HEM)	18,000	10,200	NT	43.3
Total Aromatic Hydrocarbons as BETX from EPA Method 624	53.4	10.4	0.274	80.5
PESTICIDES – detected substances only				
No compounds detected in 2014.	ND	ND	ND	---
ENTEROCOCCI BACTERIA				
Enterococci ^c	NT	1918 / 2415 3609 / 4884	NT	---
OTHER COMPONENTS				
Asbestos ^d	ND (4.06)	ND (0.81)	ND	---
Cyanide	0.9 J	1.6 J	0.21 J	---

- a* Detection limits or reporting limits are included in parentheses for non-detected (ND) values.
- b* Duplicate field or laboratory analysis provided (value / duplicate value).
- c* Enterococci reported in MPN/100 mL; two replicates (sample and duplicate).
- d* Asbestos reported in million fibers/L (influent and effluent) and present or none detected (sludge).
- i MRL/MDL elevated due to chromatographic interference.
- J Estimated value (below MRL but above MDL).
- ND Not detected.
- NT Not tested.
-
- Not applicable (not calculated).

Table 10. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge. Sampled 3 and 4 August 2014.

Pollutant	Influent^a (µg/L)	Effluent^a (µg/L)	Sludge (mg/kg)	Percent Removal
DISSOLVED METALS				
Antimony	0.322	0.374	NT	-16.1
Arsenic	1.5	2.2	NT	-46.7
Beryllium	ND (0.006)	ND (0.006)	NT	---
Cadmium	0.051	0.085	NT	-66.7
Chromium	0.70	0.76	NT	-8.6
Copper	14.8	19.3	NT	-30.4
Lead	0.376	0.496	NT	-31.9
Mercury	0.0112	0.00661	NT	41.0
Molybdenum	1.25	1.68	NT	-34.4
Nickel	2.40	2.68	NT	-11.7
Selenium	0.7 J	1.0 J	NT	---
Silver	0.046	0.041	NT	10.9
Thallium	ND (0.005)	ND (0.005)	NT	---
Zinc	23.7	34.8	NT	-46.8
TOTAL METALS				
Antimony	0.429	0.447	1.44 N	-4.2
Arsenic	2.2	2.3	5.39	-4.5
Beryllium	0.007 J	ND (0.006)	0.080	---
Cadmium	0.197	0.167	1.44	15.2
Chromium	1.93	1.09	16.6	43.5
Copper	46.0	31.6	230	31.3
Lead	1.94	1.53	20.3	21.1
Mercury `	0.0496	0.0328	0.560	33.9
Molybdenum	1.68	1.74	5.00	-3.6
Nickel	3.74	3.04	14.1	18.7
Selenium	0.8 J	0.8 J	2.05	---
Silver	0.189	0.128	2.97	32.3
Thallium	0.008 J	0.005 J	0.032	---
Zinc	122	61.1	751	49.9

Table 10. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge. Sampled 3 and 4 August 2014. (continued)

Pollutant	Influent^a (µg/L)	Effluent^a (µg/L)	Sludge^a (mg/kg)	Percent Removal
VOLATILE ORGANICS - detected substances only				
1,4-Dichlorobenzene	0.68	0.58	0.024	14.7
2-Butanone	4.8 J	16 J	12 J	---
4-Methyl-2-pentanone	ND (2.7)	ND (2.7)	0.0069 J	---
Acetone	130	140	71	-7.7
Benzene	0.20 J	0.20 J	0.0041 J	---
Bromodichloromethane	ND (0.086)	0.20 J	ND (0.00049)	---
Carbon Disulfide	0.28 J	0.52	0.072	---
Chlorobenzene	ND (0.031)	ND (0.031)	0.00095 J	---
Chloroform	2.1	4.2	0.0025 J	-100
Chloromethane	ND (0.030)	1.2	ND (0.00055)	---
cis-1,2-Dichloroethene	0.060 J	ND (0.036)	ND (0.00037)	---
Ethylbenzene	0.22 J	0.23 J	0.011 J	---
m,p-Xylenes	0.58 J	0.62 J	0.040	---
Methylene Chloride	1.4 J	3.0	0.011 J	---
o-Xylene	0.25 J	0.26 J	0.020	---
Styrene	0.070 J	0.070 J	0.0038 J	---
Tetrachloroethene	0.16 J	0.13 J	0.025	---
Toluene	3.8	5.4	0.790	-42.1
SEMI-VOLATILE ORGANICS - detected substances only				
Bis(2-ethylhexyl) Phthalate	16	12	14	25.0
Butyl Benzyl Phthalate	3.0 J	1.4 J	ND (0.29)	---
2-Chlorophenol	ND (0.42)	0.66 J	ND (0.18)	---
Chrysene	ND (0.40)	ND (0.40)	0.60 J	---
Diethyl Phthalate	4.0 J	4.3 J	ND (0.26)	---
Di-n-butyl Phthalate	0.73 J	0.76 J	0.79 J	---
Di-n-octyl Phthalate	7.6 J	7.6 J	ND (0.44)	---
Fluoranthene	ND (0.45)	ND (0.45)	1.3 J	---
Pentachlorophenol	ND (0.38)	8.0 J	ND (2.4)	---
Phenol	120	19	1.1 J	84.2
Phenanthrene	0.38 J	ND (0.24)	1.4 J	---
2,4,6-Trichlorophenol	ND (0.19)	0.74 J	ND (0.26)	---

Table 10. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge. Sampled 3 and 4 August 2014. (continued)

Pollutant	Influent ^a (µg/L)	Effluent ^{a,b} (µg/L)	Sludge (mg/kg)	Percent Removal
HYDROCARBONS				
Oil & Grease (EPA 1664-HEM)	20,400	13,900	NT	31.9
Total Aromatic Hydrocarbons as BETX from EPA Method 624	5.0	6.7	0.865	-34
PESTICIDES				
No compounds detected in 2014	ND	ND	ND	---
ENTEROCOCCI BACTERIA				
Enterococci ^c	NT	63 / 30 30 / 41	NT	---
OTHER COMPONENTS				
Asbestos ^d	ND (1.01)	ND (1.01)	ND	---
Cyanide	ND (0.9)	ND (0.9)	0.35 J	---

a Detection or reporting limits are included where possible in parentheses for non-detected (ND) values.

b Analysis or duplicate laboratory analysis provided (value/duplicate value).

c Enterococci reported in MPN/100 mL.

d Asbestos reported in million fibers/L (influent and effluent) and present or none detected (sludge).

--- Not applicable (not calculated).

J Estimated value (below MRL but above MDL).

N Matrix spike recovery not within control limits.

ND Not detected.

NT Not tested.

Semi-volatile compounds detected in both the influent and effluent during both sampling events included: bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, diethyl phthalate, di-n-butyl phthalate, and phenol. As with volatile analyses, most semi-volatile concentrations were estimated and qualified with a J as they fell below MRLs.

Volatile and semi-volatile compounds in sludge were similar to those seen in the influent and effluent for both the June and August sampling efforts. As with the influent and effluent samples, many sludge concentrations were estimated and qualified with a J as they fell below MRLs. This year, several compounds were detected in sludge that were not detected in either the influent or effluent during the June or August sampling, including: anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, flourene, pyrene, and 2-hexanone in June and 4-methyl-2-pentanone, chlorobenzene, chrysene, and fluoranthene in August.

Oil and grease concentrations measured in the influent and effluent in 2014 were similar to that seen over the previous five years with effluent concentrations of 10.2 and 13.9 mg/L during the June and August sampling compared to the 5-year range of 7.6 to 64.9 mg/L. Effluent BETX values were 10.4 and 6.7 µg/L in the June and August 2014 samplings, respectively. Refer to Sections 5.1 and 5.2 for further discussion of the significance of total hydrocarbon concentrations.

The AWQS include site-specific criteria for the Knik Arm of Cook Inlet and the Point Woronzof area and also include state-wide criteria that are based on dissolved metals. These AWQS were utilized to determine the maximum allowable effluent concentration (MAEC), defined as the receiving water AWQS criteria multiplied by the initial dilution of 142:1 for conservative substances (e.g., metals) and 180:1 for non-conservative substances (TRC, ammonia, cyanide, TAH, and TAqH) after taking into account the natural background concentration. Both total and dissolved concentrations of metals in the effluent were then compared to the MAECs. With the exception of BOD₅, TSS, fecal coliform, and TRC, MAECs are not permit specified limits, but were used as indicators in this report to determine whether the effluent approached AWQS criteria after taking into account the allowable dilution within the mixing zone.

Total recoverable metals concentrations in both the influent and effluent were found to be low. Antimony, beryllium, arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, and zinc were seen in the influent or effluent during both sampling events, all at very low levels when compared to their respective MAECs. The concentration for total copper in effluent was found to be the highest of any metals with respect to its MAEC of 317 µg/L, with a level of 39.5 µg/L during the June toxic pollutant sampling. While copper was found to be the highest metal detected in the effluent with respect to its MAEC, it was still an order of magnitude less than the MAEC.

Dissolved metals concentrations were also found to be low. Dissolved beryllium was below the MDL for influent and effluent for both sampling periods. Dissolved antimony, arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, and zinc were above detection limits in influent or effluent during at least one sampling event.

No pesticides were detected in influent, effluent, or sludge during the 2014 sampling events. For a complete list of the various chlorinated organic and pesticide analytes that were tested, refer to Appendices A1 and B1.

The permit calls for the analysis of enterococci bacteria in effluent twice per year in conjunction with the summer-dry and summer-wet sampling. Two samples were analyzed in duplicate in June and August of this year. The most probable number (MPN)/100 mL in the two samples analyzed for June 2014 were reported as 1918 and 2415 MPN/100 mL in Rep 1 and 3609 and 4884 MPN/100 mL in Rep 2. The August 2014 sampling event returned values of 63 and 60 MPN/100 mL in Rep 1 and 30 and 41 MPN/100 mL in Rep 2 for the two replicate samples taken. It is believed that the higher counts seen in June were the result of seawater intrusion and non-target marine bacteria exceeding the inhibitory capacity of the method.

Cyanide in influent, effluent, and sludge during the June sampling event were detected at estimated concentrations of 0.9 µg/L, 1.6 µg/L, and 0.21 mg/kg, respectively. Influent and effluent cyanide concentrations in August were below detection limits. Cyanide in sludge during the August sampling was an “estimated concentration” of 0.35 mg/kg. All effluent cyanide concentrations were below the MAEC of 181 µg/L.

No Dioxins, PCBs, or asbestos were detected in influent, effluent, or sludge during either June or August sampling events.

3.1.3 Pretreatment Monitoring Data

As part of the NPDES permit, AWWU is to conduct pretreatment monitoring twice per year in conjunction with toxic pollutant and pesticide analyses. This monitoring includes three consecutive days of 24-hr composite sampling of influent and effluent and one day of sludge sampling. Pretreatment analyses include cyanide and a suite of metals that are analyzed as both total and dissolved. Results of the pretreatment monitoring are presented in Table 11.

Collection of samples for trace metals analysis, as part of the toxic pollutant and pesticide sampling events in June and August 2014, coincided with the second day of the pretreatment monitoring for the Asplund WPCF during June 2014, and the first day of pretreatment monitoring in August as discussed in Section 3.1.2. Individual metals concentrations for the 3-day pretreatment sampling event were generally found to be very similar with little variation between sampling days, particularly for the effluent.

Of all the metals in the effluent, total copper, mercury, and zinc concentrations were the highest relative to water quality criteria. However, concentrations of these metals were still well below their respective MAECs. For example, dissolved copper concentrations in the effluent ranged from 20.5 to 46.1 µg/L during the three days of pretreatment sampling in June 2014 and a range of 17.9 to 20.1 µg/L during the August sampling effort as compared to the MAEC of 317 µg/L. Total copper in the effluent was found to range from 30.5 to 85.5 µg/L for the six pretreatment samples compared to the MAEC of 317 µg/L. Influent values were generally more variable than those seen in effluent, as would be expected. Dissolved zinc in the effluent ranged from 34.8 to 60.1 µg/L during both pretreatment samplings, while total zinc ranged from 61.1 to 104 µg/L during these samplings as compared to an MAEC of 11,249 µg/L. Dissolved mercury results in the effluent ranged from 0.00435 to 0.0125 µg/L in June’s effluent pretreatment samples, as compared to the MAEC of 2.73 µg/L. All total mercury samples ranged from 0.0238 to 0.0546 µg/L, well below the MAEC. Other metals were also found to be substantially less than their

Table 11. Pretreatment Monitoring Data for Influent and Effluent Metals and Cyanide.

Parameter	June 2014						August 2014					
	Influent			Effluent			Influent			Effluent		
Sample Date	10	11	12	10	11	12	4	5	6	4	5	6
Dissolved Metals (µg/L)												
Antimony*	0.438	0.543	0.404	0.448	0.571	0.457	0.322	0.433	0.495	0.374	0.447	0.454
Arsenic	1.9	2.0	1.8	2.3	2.5	2.5	1.5	1.5	1.6	2.2	2.3	2.3
Beryllium*	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Cadmium	0.051	0.039	0.050	0.098	0.083	0.088	0.051	0.058	0.037	0.085	0.095	0.072
Chromium	0.92	1.09	1.28	0.99	0.91	1.23	0.70	0.92	0.80	0.76	1.29	0.91
Copper	19.3	17.7	16.9	46.1	23.2	20.5	14.8	15.5	7.62	19.3	20.1	17.9
Lead	0.659	0.457	0.498	0.639	0.558	0.478	0.376	0.382	0.293	0.496	0.512	0.519
Mercury	0.0155	0.0120	0.0103	0.0125	0.00611	0.00435	0.0112	0.00585	0.00510	0.00661	0.0108	0.0118
Molybdenum*	4.20	2.62	3.49	1.59	4.81	3.67	1.25	1.79	3.42	1.68	1.96	3.43
Nickel	4.65	4.66	5.35	4.76	4.56	4.89	2.40	3.71	3.99	2.68	3.78	3.94
Selenium*	0.5 J	0.5 J	0.6 J	0.8 J	0.6 J	0.8 J	0.7 J	0.6 J	0.9 J	1.0 J	1.0 J	1.0
Silver	0.676	0.084	0.092	0.289	0.082	0.082	0.046	0.213	0.036	0.041	0.138	0.064
Thallium*	<0.005	0.007 J	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	40.5	28.6	32.9	60.1	54.2	50.7	23.7	22.8	21.5	34.8	43.1	42.7
Total Metals (µg/L)												
Antimony*	0.772	0.801	0.287	0.554	0.675 / 0.677	0.547	0.429	0.581	0.568	0.447	0.504	0.508
Arsenic	2.9	3.3	3.2	2.7	2.9/3.0	2.9	2.2	2.6	2.6	2.3	2.6	2.5
Beryllium*	0.014 J	0.016 J	0.017 J	0.009 J	0.011J / 0.008J	<0.006	0.007 J	0.012 J	0.021	<0.006	<0.006	0.006 J
Cadmium	0.304	0.290	0.276	0.201	0.187 / 0.186	0.185	0.197	0.362	0.276	0.167	0.180	0.189
Chromium	3.22	3.09	3.19	1.54	2.02 / 1.97	1.61	1.93	2.37	2.56	1.09	1.38	1.48
Copper	92.2	73.2	52.9	85.5	39.2/ 39.5	34.8	46.0	55.4	60.1	31.6	30.5	31.4
Cyanide	0.9 J	0.9 J	1.0 J	1.2 J	1.6 J	1.6 J	<0.9	<0.9	<0.9	<0.9	<0.9	1.0 J
Lead	3.93	3.15	3.14	1.78	1.59 / 1.59	1.60	1.94	2.21	2.47	1.53	1.26	1.64
Mercury	0.130	0.134	0.297	0.0358	0.0546	0.0298	0.0496	0.121	0.0892	0.0328	0.0238	0.0262
Molybdenum*	4.98	3.63	2.89	1.91	5.34 / 5.13	3.97	1.68	2.23	3.88	1.74	2.11	3.54
Nickel	7.58	7.10	8.63	5.38	5.40 / 5.52	5.51	3.74	5.45	5.92	3.04	4.19	4.51
Selenium*	0.8 J	0.6 J	0.7 J	0.9 J	0.8J / 0.8J	0.9 J	0.8 J	0.9 J	0.8 J	0.8 J	1.1	1.0 J
Silver	1.18	0.604	<0.004	0.650	0.296 / 0.278	0.287	0.189	0.562	0.233	0.128	0.326	0.202
Thallium*	0.006 J	<0.005	0.005 J	<0.005	<0.005 / <0.005	<0.005	0.008 J	0.008 J	0.008 J	0.005 J	0.006 J	<0.005
Zinc	206	181	215	104	94.7 / 96.4	92.9	122	165	201	61.1	75.1	77.0

Values reported as "<" (less than) are method detection limits.

* Not required by permit for "Pretreatment" monitoring.

J Result is an estimated value.

respective MAECs. Cyanide concentrations in the effluent ranged from ND (< 0.9) to an estimated concentration of 1.6 µg/L as compared to an MAEC of 181 µg/L.

3.1.4 Whole Effluent Toxicity Testing Results

Quarterly WET testing was conducted on 24-hr flow composite effluent samples as required under the permit during all four quarters of calendar year 2014. Echinoderm fertilization tests were performed using the purple sea urchin, *Strongylocentrotus purpuratus*, during the second, third, and fourth quarters of 2014. Use of this test during the second, third, and fourth quarters was based on the screening test results from the second quarter of 2013 and first quarter of 2014 which had determined the sea urchin to be the most sensitive species tested (see Section 2.1.4).

Annual re-screening for the most sensitive species in 2014 was performed during the first quarter. Based on the interpretation of the detailed laboratory results, the laboratory recommended continuing with the sea urchin as the most sensitive species for subsequent testing until the annual three-species rescreening is performed again during 2015.

Results of all the tests performed in 2014 are summarized below and presented in Table 12 as the lowest observed effect concentration (LOEC), no observed effect concentration (NOEC), and in chronic toxicity units (TUC), where TUC = 100/NOEC. Detailed results in the form of descriptive laboratory reports that present all data in tabular form along with statistical analyses, quality assurance/quality control (QA/QC) information, and reference toxicant test results have previously been submitted to ADEC and EPA with Asplund WPCF's monthly discharge monitoring reports (DMRs) and are not duplicated in this report.

Table 12. Summary of WET Test Data from 2014.

Toxicity Test	LOEC (%)	NOEC (%)	TUC
1st Quarter 2014			
Echinoderm (fertilization)	2.8	1.4	71.4
Bivalve (survival)	>2.8	2.8	≤35.7
Bivalve (development)	>2.8	2.8	≤35.7
Topsmelt (survival)	>2.8	2.8	≤35.7
Topsmelt (growth)	>2.8	2.8	≤35.7
2nd Quarter 2014			
Echinoderm (fertilization)	>2.8	2.8	≤35.7
3rd Quarter 2014			
Echinoderm (fertilization)	2.8	1.4	71.4
4th Quarter 2014			
Echinoderm (fertilization)	>2.8	2.8	≤35.7

- Note: Toxic trigger in Permit for additional testing is a TUC of 143.

WET testing was performed on three species during the first quarter of 2014 on February 17th through the 21st. The WET tests included: the bivalve larva, *Mytilus galloprovincialis* survival and development; topmelt, *Atherinops affinis* survival and growth; and echinoderm, *Strongylocentrotus purpuratus* fertilization.

Results of the bivalve and topmelt bioassay tests showed that no concentration of effluent that was tested produced any toxicity to the test organisms. The NOECs for survival, growth, and development were 2.8% effluent and all LOECs were > 2.8% effluent, the highest concentration tested. Chronic toxicity units were ≤ 35.7 TUC for both survival and development in the bivalves and ≤ 35.7 TUC for both survival and growth in the topmelt. The concurrent reference toxicant test results were within laboratory control chart limits and indicated typical sensitivity of the test populations. All test acceptance criteria (TAC) were met in both the effluent bioassay and the reference toxicant bioassay for both species.

Results of the echinoderm fertilization test showed that the NOEC for fertilization was 1.4% effluent and the LOEC was 2.8% effluent. Echinoderm chronic toxicity units were 71.4 TUC. Based on the results of the three-species testing and past years' results, it was recommended to continue to use the urchin as the most sensitive species for the toxicity testing to be conducted in the subsequent quarters of 2014 and until the three-species comparison is repeated in 2015.

The second quarter sampling event was conducted 12 June 2014. The NOECs for fertilization were 2.8% effluent and the LOECs were > 2.8% effluent. Chronic toxicity units were ≤ 35.7 TUC. All TAC were met in both the effluent bioassay and the reference toxicant bioassay.

The third quarter echinoderm fertilization testing was performed on single 24-hr composite sample collected on 4 August 2014. The LOEC concentration was 2.8% effluent with a NOEC concentration of 1.4% effluent. Chronic toxicity units were 71.4 TUC. All TAC were met in both the effluent and reference toxicant bioassay.

The WET testing for the fourth quarter with echinoderms was performed on samples collected 20 October 2014. Results of the test showed that no concentration of effluent that was tested produced any toxicity to the test organisms. The NOEC for fertilization was 2.8% effluent and the LOEC was > 2.8% effluent. Chronic toxicity units were ≤ 35.7 TUC. All TAC were met in both the effluent and reference toxicant bioassay.

3.1.5 Part 503 Sludge Monitoring Data

AWWU operates a sludge incinerator at the Asplund WPCF for which the permit requires sludge monitoring twice per year as part of the Toxic Pollutants and Pesticides/Pretreatment monitoring. During 2014, the Part 503 sludge monitoring was performed at a frequency of eight times per year. These data will be submitted along with other incinerator operational information to EPA by 19 February 2015 as a separate report; however, for completeness and comparison purposes, this information is included here as well.

Results of the sludge monitoring for metals for the year are presented in Table 13. All metals concentrations were extremely low compared to allowable limits. Maximum results for all metals tested (arsenic, beryllium, cadmium, chromium, lead, mercury, and nickel) were at the low end

Table 13. Part 503 Discharge Monitoring Data for Metals Concentrations in Sludge in mg/kg.

Parameter	Arsenic	Beryllium ^{b,d}	Cadmium	Chromium	Lead	Mercury ^{c,d}	Nickel
Site Specific Limit^{a,e}	99	2014	88	1937	5045	129	6727
01/15/14	2.7	0.05	0.99	11.3	8.8	0.37	8.99
03/21/14	3.4	0.06 J	1.2	15	15	0.73	12
05/28/14	4.3	0.068	1.3	15	18	0.59	13
06/11/14	5.26 / 4.82	0.067 / 0.062	1.12 / 1.17	15.2 / 14.0	14.1 / 14.7	0.590	14.3 / 12.6
07/28/14	4.96	0.084	1.25	16.7	18.7	0.60	14.8
08/03/14	5.39	0.080	1.44	16.6	20.3	0.560	14.1
09/26/14	5.80	0.080	1.21	13.7	14.6	0.32	11.9
11/24/14	4.91	0.052	1.45	14.6	14.0	0.46	11.1
MINIMUM	2.7	0.05	0.99	11.3	8.8	0.32	8.99
MAXIMUM	5.8	0.084	1.45	16.7	20.3	0.73	14.8
AVERAGE ^g	4.6	0.07	1.25	14.8	15.4	0.53	12.5

^a Site-specific sludge limits calculated by ERM Alaska Inc. August 2014, based primarily on September 2012 Asplund Incinerator Source Test.

^b Beryllium emissions shall not exceed 10 grams per day. With a control efficiency of 0.9998 at the maximum sludge feed rate, a sludge concentration of 2014 milligrams per dry kilogram of sludge will not result in a violation of the limit.

^c Mercury emissions shall not exceed 3,200 grams per day. With a control efficiency of 0.0 at the maximum sludge feed rate, a sludge concentration of 129 milligrams per dry kilogram of sludge will not result in a violation of the limit.

^d Monitoring frequencies required by 40 CFR Part 503 for incineration are once per 60 days for arsenic, cadmium, chromium, lead, and nickel. Mercury is at least once per year. Frequency for beryllium is not specified. AWWU has chosen to test mercury and beryllium more frequently than required to be consistent with the other metals.

^e Concentrations are in mg/kg dry weight and reported as total metals.

^J Estimated value (below MRL but above MDL).

of their historic ranges compared to the past five years. As mentioned previously, no actual sludge limits exist in the current NPDES permit. Allowable limits are site-specific and were calculated by the permittee per Part 503 regulations (ERM, 2014). EPA may issue sludge only permits in the future; in the interim, 40 CFR Part 503 regulations are “self-implementing.”

3.2 RECEIVING WATER QUALITY MONITORING RESULTS

Water quality sampling of the receiving water was conducted on 11 - 12 June 2014, concurrent with the summer-dry sampling. Sampling results are contained in the following subsections.

3.2.1 Plume Dispersion Sampling

Drogue Tracking Results

Drogues were released on 11 June 2014 at the ZID station for the ebb and flood tidal cycles and on 12 June 2014 at the control station for the flood tidal cycle. Three drogues were deployed during each tidal cycle and four stations sampled along each drogue track.

ZID Site

The Point Woronzof ebb drogue drop and tracking cycles were performed during the morning of 11 June 2014. The predicted tidal range during ebb stage was 31.1 ft (Figure 5 and Table 14; NOAA Tides and Currents, 2014). Table 14 also lists the individual drogue travel times as well as average drogue speed. A composite of the ebb drogue deployments is depicted in Figure 6 and the tracks are very similar to those seen in previous years.

The ebb drogues traveled from approximately 2.9 to 4.0 nautical miles, with the first drogue traveling in a westerly direction and the next two traveling in a west southwesterly direction. No eddies were observed during these drogue tracks, nor did any of the drogues become grounded. The first ebb (E1) drogue was released at 06:48 Alaska Daylight Time (ADT), 24 minutes (min) after high tide. The release of E1 at the outfall occurred shortly after the tide turned from flood to ebb and the drogue traveled in a westerly direction. The drogue traveled at an average speed of 138 centimeters per second (cm/s) over its entire track of approximately 2.9 nautical miles. The second ebb drogue (E2) was released at 08:14 ADT and tracked north of the Woronzof Shoal, traveling west southwest with an average speed of 140 cm/s, traveling approximately 4.0 nautical miles. The third drogue (E3) was released at 10:19 ADT, about four hrs after high slack. The third drogue followed a similar path to the E2 drogue traveling in a west southwesterly direction. This drogue traveled approximately 3.7 nautical miles at 113 cm/s over its entire track. The drogue track relationships with respect to the tide are shown in Figure 5.

Flood drogue tracks are depicted in Figure 7. The tidal range during flood stage was 29.7 ft (Figure 5 and Table 14; NOAA, 2014). The first flood drogue (F1) was deployed on 11 June at 13:35 ADT, 4 min after low slack water at the outfall. This drogue traveled easterly before hooking sharply toward the shoreline on the east side of Point Woronzof traveling approximately 1.0 nautical mile at an average speed of 37 cm/s. The second flood drogue (F2) was deployed at 15:05 ADT, 1 hr and 34 min after low slack. This drogue was transported initially to the northeast then more easterly and further offshore than the first drogue where it spent some time in an eddy generated by current flooding past Point Woronzof. It tracked for about 1.5

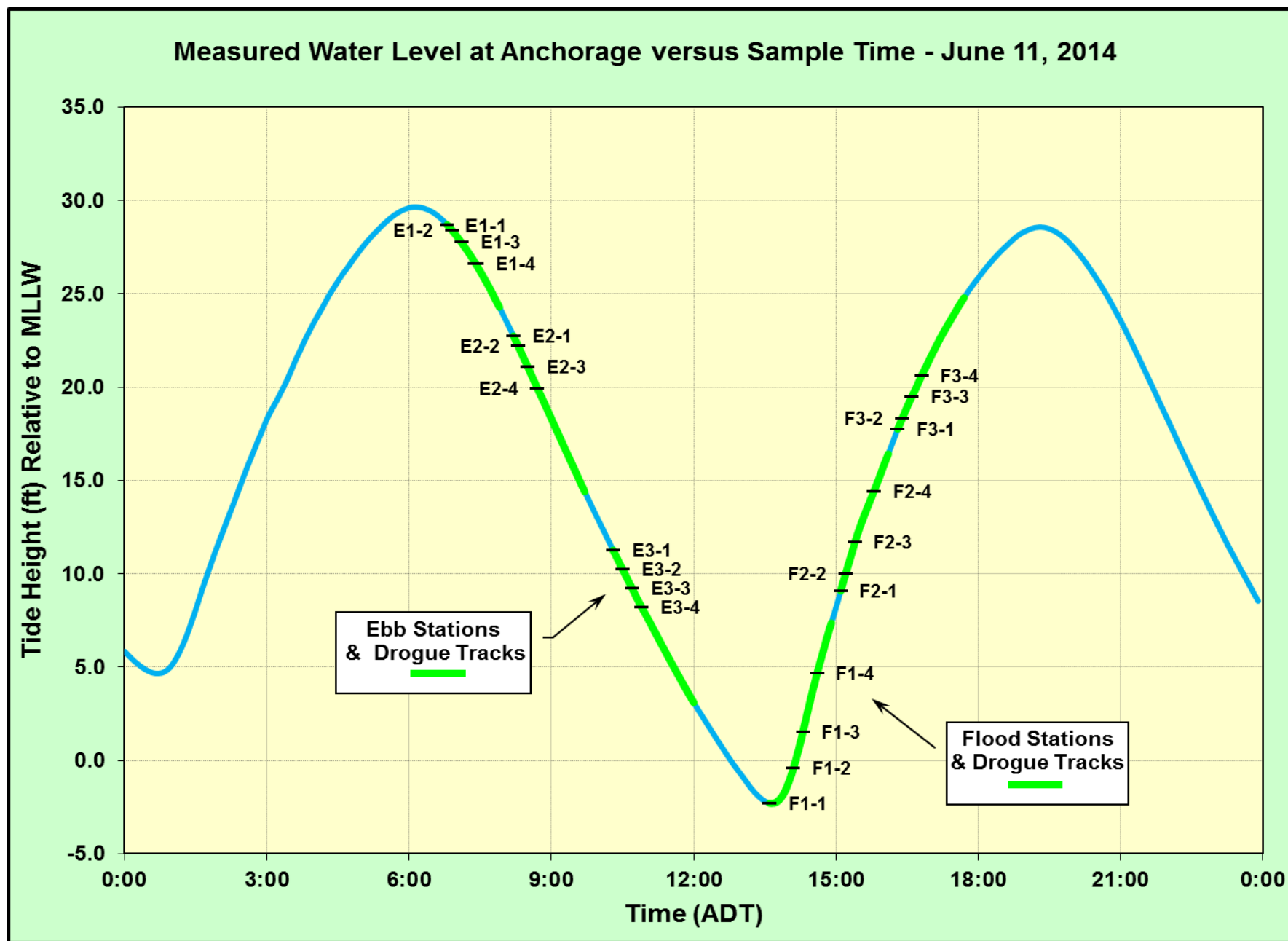


Figure 5. Tidal Information for Receiving Water Sampling, Ebb and Flood Tides.

Table 14. 2014 Drogue Tracking Information.

Date	Station	Tidal Information				Drogue No.	Release Time After Slack (Hr:Min)	Drogue Track Time (Hr:Min)	Average Drogue Speed (cm/s)
		Slack Water (Alaska Daylight Time ^a ; Stage)		Direction	Range (Feet)				
11 June 2014	Outfall	06:24	HIGH	EBB	31.1	E1	00:24	1:05	138
11 June 2014	Outfall	06:24	HIGH	EBB	31.1	E2	01:50	1:28	140
11 June 2014	Outfall	06:24	HIGH	EBB	31.1	E3	03:55	1:41	113
11 June 2014	Outfall	13:31	LOW	FLOOD	29.7	F1	00:04	1:21	37
11 June 2014	Outfall	13:31	LOW	FLOOD	29.7	F2	01:34	1:05	72
11 June 2014	Outfall	13:31	LOW	FLOOD	29.7	F3	02:49	1:18	156
12 June 2014	Control	14:19	LOW	FLOOD	31.9	C1	-00:04	1:28	64
12 June 2014	Control	14:19	LOW	FLOOD	31.9	C2	01:38	1:10	197
12 June 2014	Control	14:19	LOW	FLOOD	31.9	C3	03:29	1:08	227

^a NOAA tides and Currents 2014 (Port of Anchorage, Alaska).

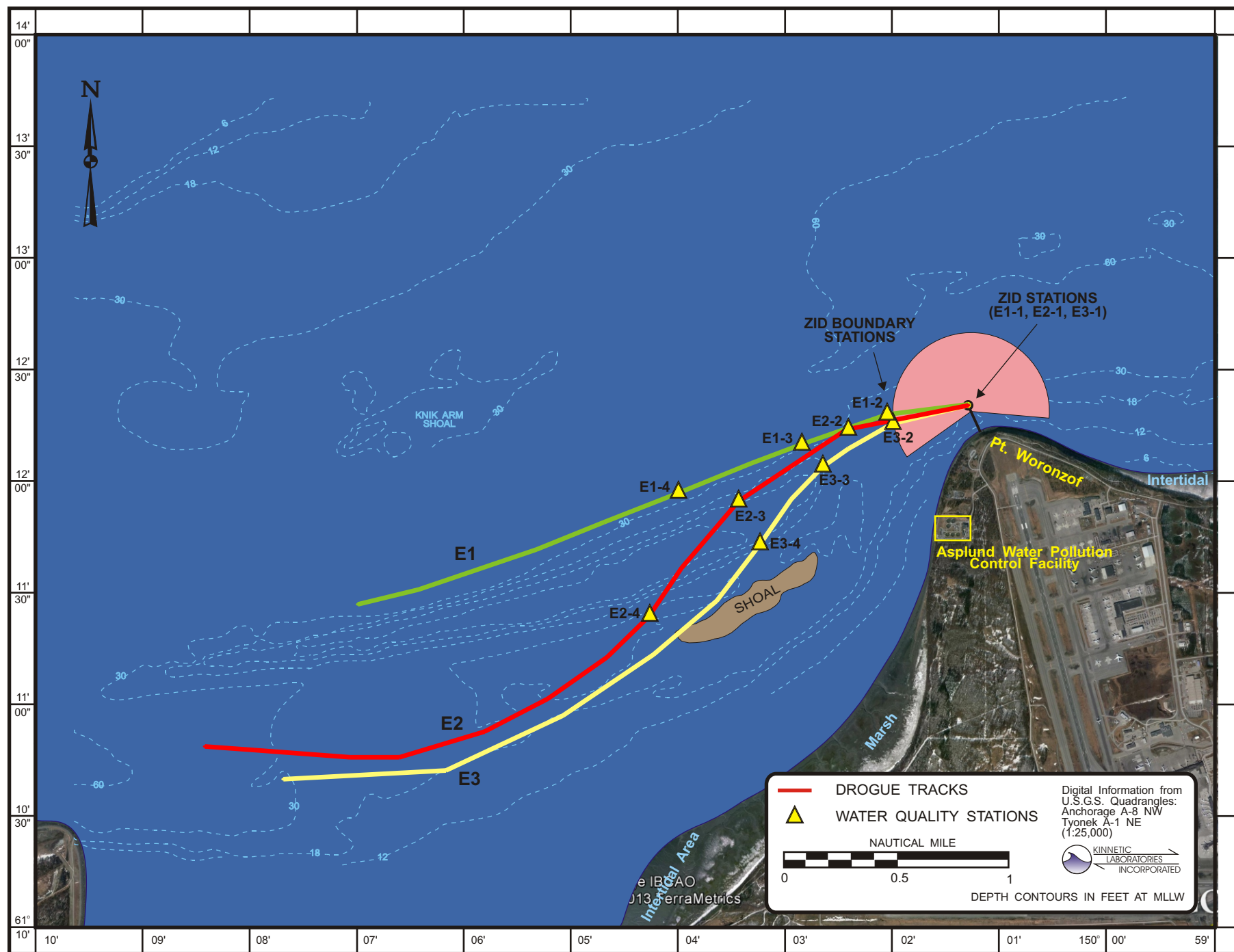


Figure 6. Summary of Ebb Drogue Tracks and Receiving Water Sampling Locations at Point Woronzof, 11 June 2014.

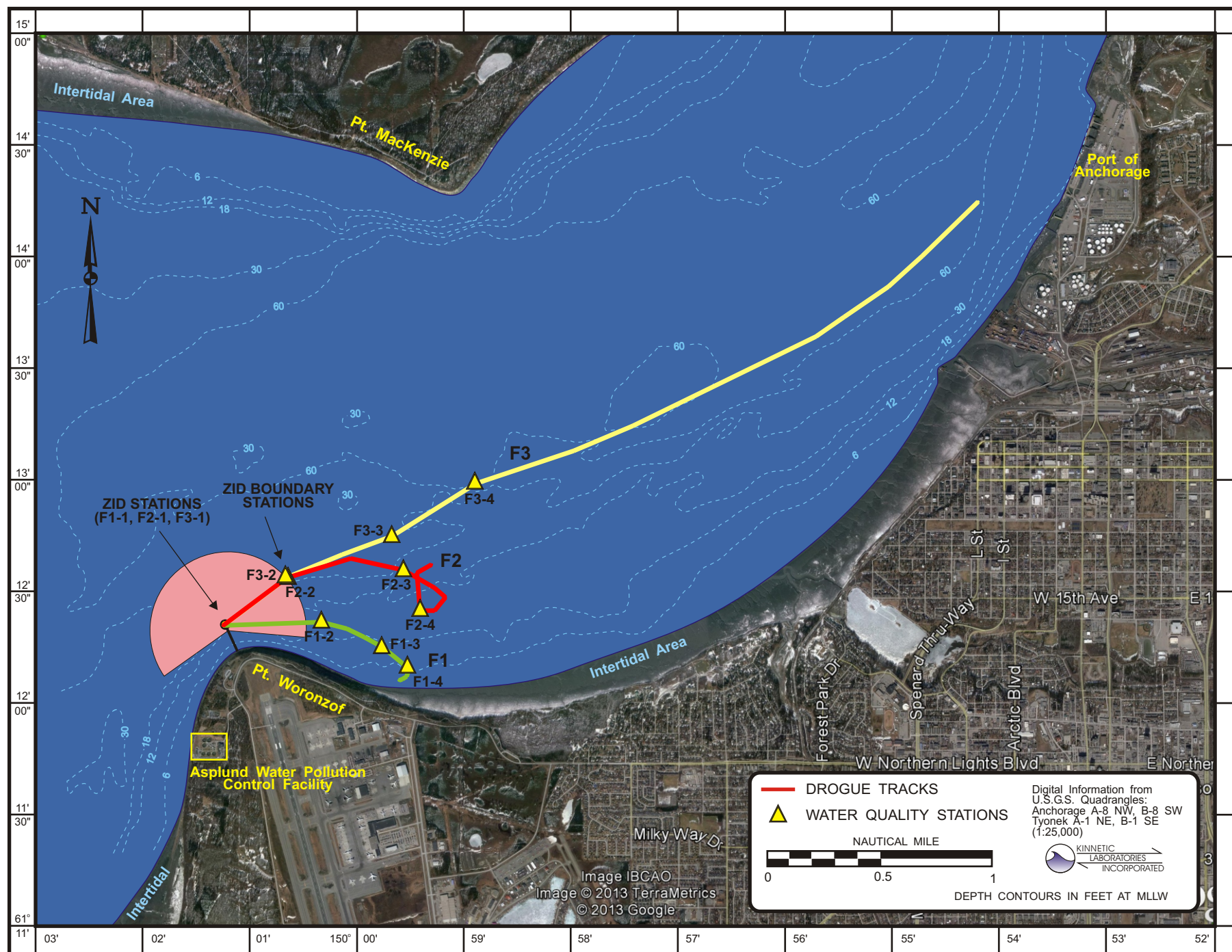


Figure 7. Summary of Flood Drogue Tracks and Receiving Water Sampling Locations at Point Woronzof, 11 June 2014.

nautical miles at an average speed of 72 cm/s before it was retrieved. The third flood drogue (F3) was deployed at 16:20 ADT, approximately 3 hrs after low slack water, and tracked for about 1 hr. The third drogue traveled northeast in the central Knik Arm Channel with an average speed of 156 cm/s. This drogue was tracked for approximately 3.9 nautical miles and was recovered 0.5 nautical miles offshore and to the west of the Port of Anchorage.

Control Site

The Point MacKenzie control drogues were deployed and tracked on 12 June 2014. The predicted tidal range during the flood tide was 31.9 ft. Tidal information is provided in Figure 8 and Table 14 (NOAA, 2014). A composite of the three drogue trajectories at the control site is presented in Figure 9 which is very similar to prior years. The relationship of drogue tracks with respect to the tide and when sampling took place are shown in Figure 8.

The three control drogues had very similar tracks with the first drogue tracking closest to shore and the latter two drogues tracking further offshore in the center portion of the Knik Arm Channel. The first drogue (C1) was released at 14:15 ADT, 4 min before low tide, and traveled to the east and then to the northeast parallel to the shoreline. This drogue traveled 1.8 nautical miles with an average speed of 64 cm/s over the entire track before being retrieved after possibly grounding about a mile and a quarter from Port MacKenzie. The second drogue (C2) was released at 15:57 ADT, 1 hr and 38 min into the flood tidal cycle, and tracked for about one hr. This drogue had an average speed of 197 cm/s over the entire track and moved towards the northeast and offshore from the first drogue track in the central portion of the main channel. The second drogue eventually was retrieved north of Port MacKenzie after traveling 4.5 nautical miles. The third control drogue (C3) was released at 17:48 ADT, approximately 3½ hrs after low slack water. The drogue traveled in a manner very similar to the second drogue moving northeast into the central channel with an average speed of 227 cm/s, traveling 4.9 nautical miles when it was retrieved mid-channel between the east and west shorelines.

Summary of Receiving Water Quality Data

The summer Cook Inlet receiving water quality sampling for all analysis types was conducted concurrently with the drogue tracking studies on 11 - 12 June 2014. As discussed previously, three drogues were released at the ZID for both ebb and flood tides and three were released at the control site for the flood tide. Water samples and CTD measurements were obtained at four stations along each drogue's track prior to their being retrieved. In the current NPDES permit, the ZID boundary is located at a distance of 650 m from the outfall diffuser. To accomplish the ZID site sampling station, the vessel was positioned directly up-current from the diffuser and allowed to drift down across it. Upon reaching the outfall diffuser, the drogue was dropped and the within-ZID station was immediately sampled. The distance from the outfall diffuser to the drogue was monitored with the DGPS, and upon reaching 650 m distance from the diffuser, the ZID-boundary station was immediately sampled adjacent to the drogue. The third and fourth stations were then sampled along the drogue's path. Due to high current speeds, anchoring the vessel and sampling at each station was not practical or desirable due to the large wire angles of sampling gear, safety concerns, quickness needed in sampling, and less representative sampling that would result.

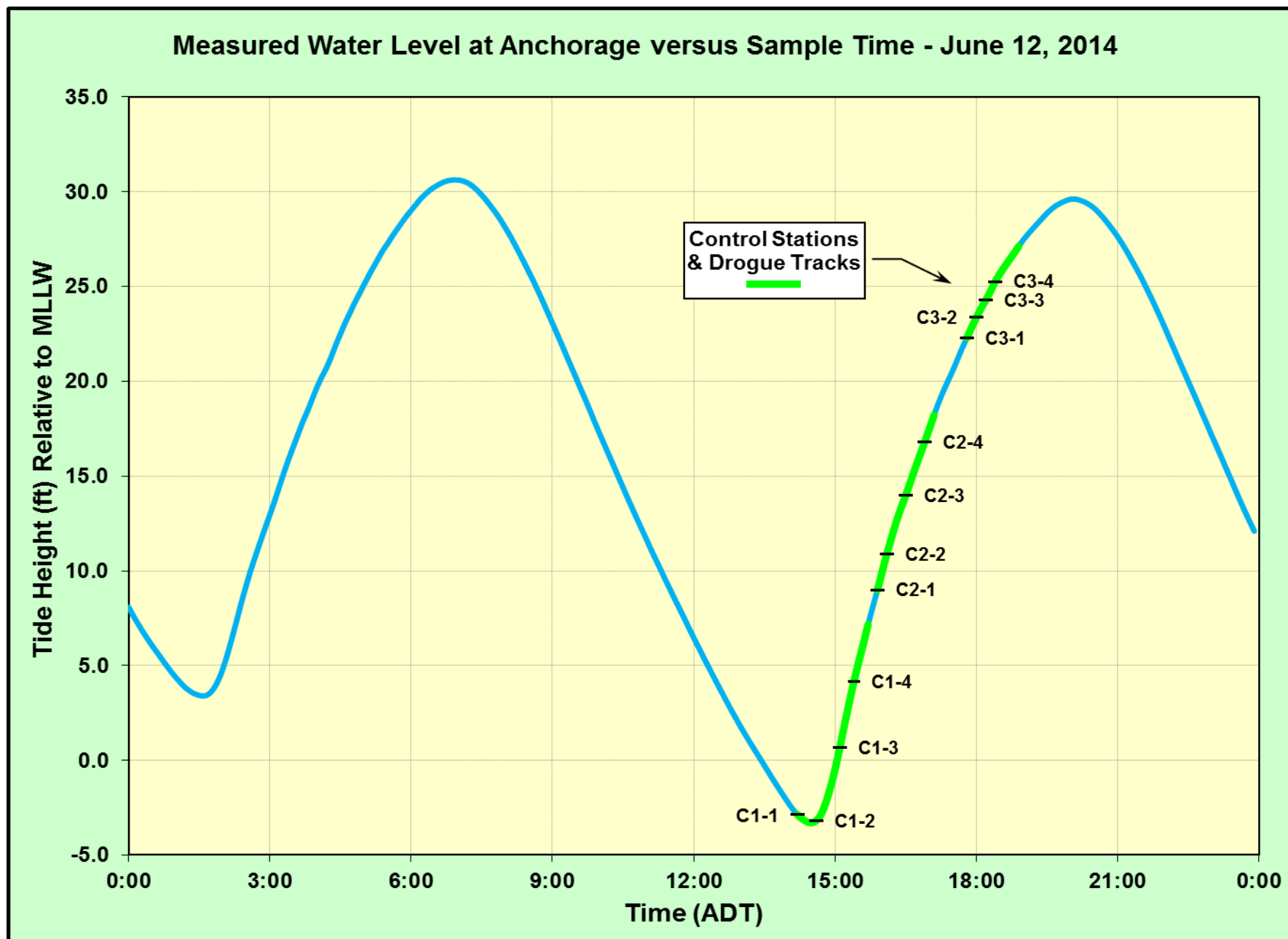


Figure 8. Tidal Information for Receiving Water Sampling, Control Tide.

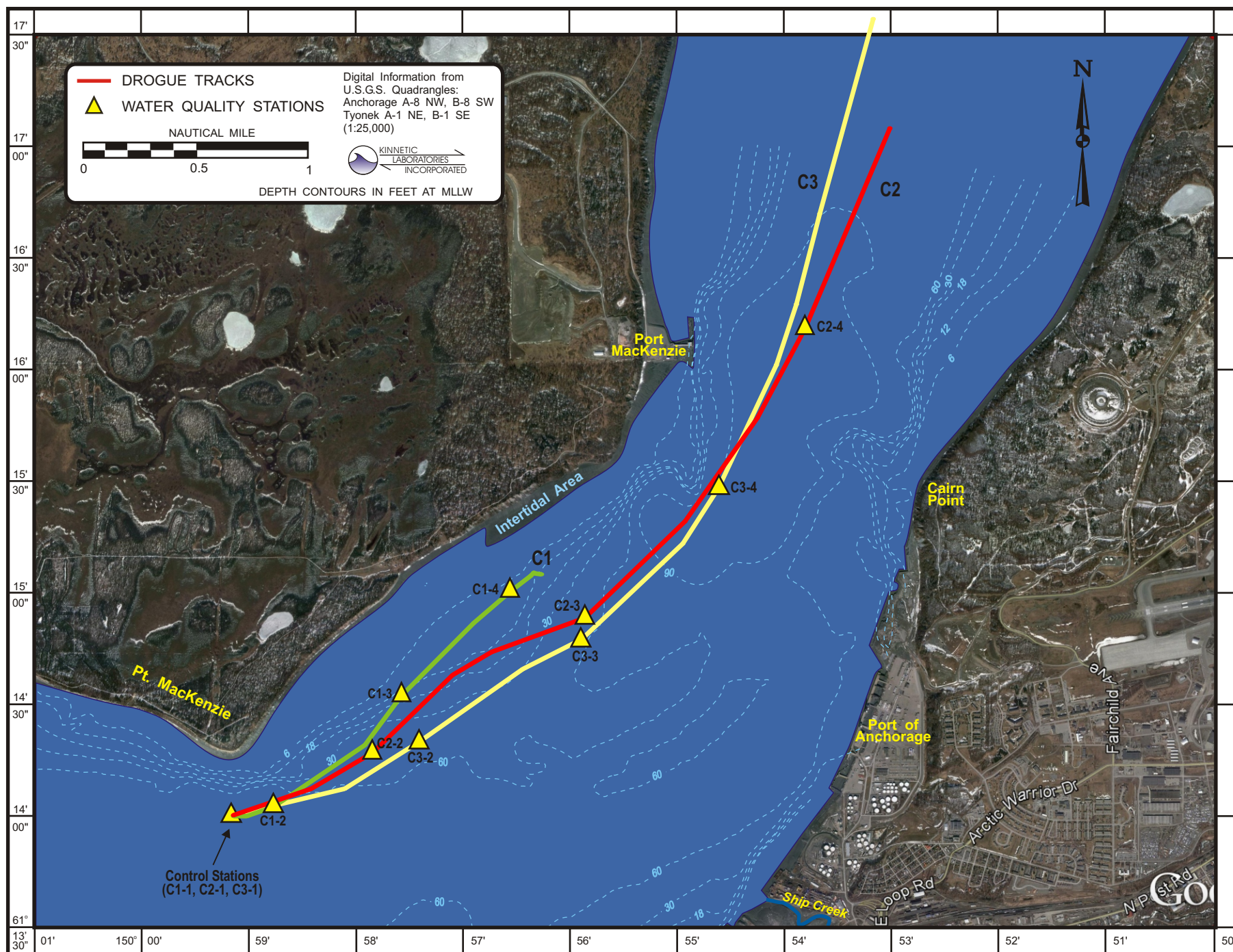


Figure 9. Summary of Control Drogue Tracks and Receiving Water Sampling Locations at Point MacKenzie, 12 June 2014.

In the field, in addition to unique sample numbers, samples were coded on their labels by location and depth to provide easy field identification of the water quality measurements obtained. The station designation was represented by: drogue drop location (C=control, E=ebb, and F=flood), the first number represents the drogue number, and the second number represents the station along the drogue's path. The final character represents surface (S), mid-depth (M), or bottom (B) sample (e.g., Station C2-3B).

The waters of the inlet are extremely well-mixed both vertically and horizontally, as indicated by the CTD data. During the survey, water temperatures seen in the surface, middle, and bottom samples were in a narrow range with a minimum of 10.69 °C and a maximum of 12.83 °C, with warmer temperatures generally seen at the control station locations and closer to the surface (Table 15). Salinities were found to vary from a minimum of 12.86 parts per thousand practical salinity units (psu) to a maximum of 17.45 psu. Salinities were generally found to increase slightly during the flood and decrease on the ebb, as is typical for estuaries. As has been often seen in the past, the control stations were found to be slightly warmer and less saline due to a greater influence from river runoff on the north side of Knik Arm. Also, some sites exhibited a fresher water lens that was evident at the surface in the CTD data. Values for pH ranged from 7.53 to 7.76 with little to no vertical stratification and no noticeable difference between the outfall and control sites. Values for DO collected in-situ by the CTD ranged from 9.47 to 9.94 mg/L with most concentrations being at or near 100 percent saturation (UNESCO, 1973).

Representative hydrographic profiles of water quality are presented for a ZID boundary station during flood tide, Station F2-2, and a typical control station, Station C2-3 (Figure 10). The water column was found to be fairly well mixed from the surface to the bottom at all stations, although some stations did exhibit some slight temperature and salinity stratification. This stratification was not attributed to the outfall but was due to freshwater influences from local river inputs. Refer to Appendix C7 for CTD profile plots and detailed data from each water quality station.

Surface samples were obtained at each station for the analysis of color, TRC, fecal coliform bacteria, and turbidity. Color values were quite variable and found to range from <5 to 15 color units on the platinum-cobalt scale.

During 2014, all measured receiving water TRC concentrations were below the MDL of 0.010 mg/L. The effluent TRC concentration measured by the AWWU plant during the 11 June receiving water sampling was 0.40 mg/L, which is much lower than maximum daily permit limit of 1.2 mg/L. It should be noted that the lowest achievable MDL due to seawater matrix interferences for TRC analysis was between the AWQS 1-hr average acute limit of 0.013 mg/L and the 4-day chronic limit of 0.0075 mg/L. Also, the MDL that was achieved is an order of magnitude less than the 0.10 mg/L limit that ADEC considers achievable for regulatory purposes. The ion selective electrode method (SM 4500 Cl-I) was used for the receiving water sampling to reduce interferences from common oxidizing agents, temperature, turbidity, and color; all TRC methods are subject to positive interferences in estuarine or marine waters.

Table 15. Hydrographic and Water Quality Data, 11 and 12 June 2014.

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp ^a (°C)	Salinity ^a (‰)	pH ^b (units)	DO ^a (mg/L)	Turbidity ^c (NTU)	Color ^c (units)	TRC ^c (mg/L)	Fecal Coliform ^{c,d}
June 11												
E1-1S	0648	61°12.343'	150° 01.280'	0.5	11.46	15.29	7.59	9.65	179	10	ND (0.010)	<1.8
-1M				5.5	11.45	15.51	7.63	9.82	436			
-1B				11.0	11.04	16.70	7.60	9.92	655			
E1-2S	0656	61°12.297'	150° 02.040'	0.5	11.38	15.66	7.61	9.61	392	10	ND (0.010) / ND (0.010)	<1.8
-2M				7.5	11.14	16.33	7.60	9.86	415			
-2B				15.0	10.71	17.45	7.59	9.92	289			
E1-3S	0707	61° 12.164'	150° 02.835'	0.5	11.37	15.61	7.64	9.70	335	10	ND (0.010)	<1.8
-3M				8.0	10.92	16.64	7.63	9.90	336			
-3B				15.5	10.72	17.28	7.63	9.94	303			
E1-4S	0723	61° 11.947'	150° 03.990'	0.5	11.30	15.74	7.64	9.76	368 / 350	10	ND (0.010)	2.0
-4M				8.0	10.93	16.65	7.66	9.88	243			
-4B				16.0	10.69	17.36	7.65	9.94	380			
E2-1S	0814	61° 12.340'	150° 01.278'	0.5	11.36	16.01	7.69	9.73	440	10	ND (0.010)	2.0
-1M				5.0	11.36	16.01	7.72	9.75	476			
-1B				10.0	11.35	16.02	7.71	9.73	512			
E2-2S	0821	61° 12.232'	150° 02.420'	0.5	11.24	16.19	7.70	9.47	535	10	ND (0.010) / ND (0.010)	<1.8
-2M				7.0	11.24	16.27	7.70	9.75	592			
-2B				14.0	11.21	16.34	7.69	9.77	541			
E2-3S	0830	61° 11.909'	150° 03.430'	0.5	11.26	15.34	7.74	9.60	518	5.0	ND (0.010)	<1.8
-3M				5.5	11.22	16.32	7.73	9.74	540 / 553			
-3B				11.0	11.21	16.34	7.73	9.75	512			

Table 15. Hydrographic and Water Quality Data, 11 and 12 June 2014. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp ^a (°C)	Salinity ^a (‰)	pH ^b (units)	DO ^a (mg/L)	Turbidity ^c (NTU)	Color ^c (units)	TRC ^c (mg/L)	Fecal Coliform ^{c,d}
E2-4S	0843	61° 11.394'	150°04.270'	0.5	11.17	16.38	7.76	9.77	455	10	ND (0.010)	<1.8
-4M				4.0	11.17	16.38	7.75	9.77	494			
-4B				8.0	11.17	16.39	7.74	9.80	495			
E3-1S	1019	61° 12.340'	150° 01.281'	0.5	11.70	14.79	7.66	9.73	661	10	ND (0.010)	2.0
-1M				3.5	11.69	14.93	7.69	9.71	668			
-1B				7.0	11.69	14.89	7.69	9.71	672			
E3-2S	1028	61° 12.254'	150° 01.989'	0.5	11.70	14.88	7.70	9.68	626	10 / 10	ND (0.010)	<1.8/<1.8/ <1.8
-2M				4.5	11.70	14.89	7.69	9.70	701			
-2B				9.0	11.69	14.89	7.69	9.71	704 / 722			
E3-3S	1040	61° 12.064'	150° 02.642'	0.5	11.72	14.89	7.74	9.68	630	15	ND (0.010)	2.0
-3M				4.5	11.70	14.89	7.76	9.69	705			
-3B				8.5	11.70	14.89	7.75	9.69	716			
E3-4S	1054	61° 11.718'	150° 03.225'	0.5	11.73	14.82	7.58	9.73	581	5.0	ND (0.010) / ND (0.010)	<1.8
-4M				3.5	11.70	14.88	7.64	9.72	704			
-4B				6.5	11.70	14.88	7.67	9.73	728			
F1-1S	1335	61° 12.342'	150° 01.278'	0.5	12.19	14.50	7.44	9.73	217	15	ND (0.010) / ND (0.010)	17
-1M				1.0	12.15	14.50	7.56	9.74	244			
-1B				1.5	12.14	14.50	7.58	9.75	254			
F1-2S	1405	61° 12.356'	150° 00.359'	0.5	12.19	14.35	7.53	9.68	274	10	ND (0.010)	4.5
-2M				1.0	12.18	14.35	7.54	9.69	289			
-2B				2.0	12.18	14.35	7.59	9.69	329			
F1-3S	1420	61° 12.245'	149° 59.789'	0.5	12.30	14.50	7.61	9.73	259	10	ND (0.010)	<1.8
-3M				1.0	12.28	14.50	7.70	9.73	287			
-3B				1.5	12.28	14.50	7.68	9.73	300			

Table 15. Hydrographic and Water Quality Data, 11 and 12 June 2014. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp ^a (°C)	Salinity ^a (‰)	pH ^b (units)	DO ^a (mg/L)	Turbidity ^c (NTU)	Color ^c (units)	TRC ^c (mg/L)	Fecal Coliform ^{c,d}
F1-4S	1437	61° 12.148'	149° 59.553'	0.5	12.50	14.50	7.70	9.68	195	10	ND (0.010)	<1.8
-4M				1.0	12.48	14.49	7.72	9.68	220 / 225			
-4B				2.0	12.47	14.49	7.71	9.70	228			
F2-1S	1505	61° 12.342'	150° 01.280'	0.5	12.21	14.91	7.67	9.71	758	ND (5.0)	ND (0.010)	<1.8
-1M				2.5	12.18	14.97	7.69	9.72	802			
-1B				4.5	12.20	14.97	7.68	9.71	772			
F2-2S	1511	61° 12.555'	150° 00.687'	0.5	12.24	15.05	7.70	9.71	657	ND (5.0)	ND (0.010)	<1.8
-2M				4.5	12.29	15.14	7.71	9.69	767			
-2B				9.0	12.35	15.19	7.72	9.67	784			
F2-3S	1522	61° 12.590'	149° 59.596'	0.5	12.39	14.84	7.66	9.67	507 / 527	ND (5.0)	ND (0.010)	<1.8
-3M				4.0	12.21	14.90	7.69	9.67	830			
-3B				7.5	12.30	15.01	7.70	9.66	882			
F2-4S	1550	61° 12.410'	149° 59.436'	0.5	12.33	14.93	7.58	9.67	467	ND (5.0) / ND (5.0)	ND (0.010) / ND (0.010)	<1.8
-4M				4.0	12.27	15.15	7.60	9.67	719			
-4B				7.5	12.34	15.24	7.61	9.68	812			
F3-1S	1620	61° 12.342'	150° 01.275'	0.5	12.06	14.49	7.71	9.72	625	ND (5.0)	ND (0.010)	<1.8
-1M				4.0	12.05	14.51	7.72	9.72	678			
-1B				8.0	12.05	14.53	7.72	9.73	687			
F3-2S	1626	61° 12.561'	150° 00.666'	0.5	12.04	14.60	7.67	9.70	586	ND (5.0)	ND (0.010)	<1.8/<1.8/2.0
-2M				6.5	11.97	14.74	7.71	9.72	686			
-2B				12.5	11.99	14.73	7.73	9.72	682			
F3-3S	1637	61° 12.742'	149° 59.699'	0.5	12.25	14.22	7.70	9.70	456 / 470	ND (5.0)	ND (0.010)	<1.8
-3M				7.0	11.86	15.07	7.72	9.69	529			
-3B				13.5	11.73	15.47	7.73	9.74	637			

Table 15. Hydrographic and Water Quality Data, 11 and 12 June 2014. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp ^a (°C)	Salinity ^a (‰)	pH ^b (units)	DO ^a (mg/L)	Turbidity ^c (NTU)	Color ^c (units)	TRC ^c (mg/L)	Fecal Coliform ^{c,d}
F3-4S	1647	61° 12.977'	149° 58.915'	0.5	12.16	14.47	7.71	9.74	406	ND (5.0) / ND (5.0)	ND (0.010)	<1.8
-4M				8.0	11.66	15.54	7.72	9.72	563			
-4B				15.5	11.65	15.52	7.73	9.70	606			
June 12												
C1-1S	1415	61° 14.000'	149° 59.154'	0.5	12.76	13.25	7.53	9.77	86	15	ND (0.010)	<1.8
-1M				6.5	12.03	13.33	7.55	9.78	184			
-1B				13.0	12.01	13.19	7.57	9.81	599			
C1-2S	1435	61° 14.042'	149° 58.782'	0.5	12.83	13.35	7.68	9.77	124	10	ND (0.010)	<1.8
-2M				1.5	12.12	13.38	7.67	9.80	472			
-2B				2.5	12.03	13.24	7.70	9.77	938			
C1-3S	1505	61° 14.540'	149° 57.583'	0.5	12.45	13.37	7.71	9.76	425	10	ND (0.010) / ND (0.010)	<1.8
-3M				1.0	12.45	13.34	7.69	9.76	619 / 682			
-3B				1.5	12.46	13.28	7.70	9.76	595			
C1-4S	1522	61° 15.008'	149° 56.565'	0.5	12.54	13.23	7.72	9.78	471	10	ND (0.010)	<1.8
-4M				1.0	12.51	13.24	7.71	9.77	631			
-4B				2.0	12.51	13.24	7.71	9.78	661			
C2-1S	1557	61° 14.005'	149° 59.149'	0.5	12.33	13.33	7.72	9.75	405	10	ND (0.010)	<1.8
-1M				6.5	12.31	13.35	7.72	9.75	414			
-1B				13.0	12.30	13.35	7.72	9.75	516 / 528			
C2-2S(A)	1607	61° 14.295'	149° 57.857'	0.5	12.31	13.31	7.73	9.75	410	15	ND (0.010)	<1.8
-2S(B)				0.5	12.31	13.32	---	9.74	---	10	ND (0.010)	<1.8
-2S(C)				0.5	12.29	13.37	---	9.74	---	5.0 / 5.0	ND (0.010)	<1.8
-2M				3.0	12.28	13.38	7.71	9.69	552			
-2B				5.5	12.26	13.39	7.71	9.75	629			

Table 15. Hydrographic and Water Quality Data, 11 and 12 June 2014. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp ^a (°C)	Salinity ^a (‰)	pH ^b (units)	DO ^a (mg/L)	Turbidity ^c (NTU)	Color ^c (units)	TRC ^c (mg/L)	Fecal Coliform ^{c,d}
C2-3S(A)	1629	61° 14.866'	149° 55.860'	0.5	12.28	13.42	7.73	9.75	431	10	ND (0.010)	<1.8
-3S (B)				0.5	---	---	---	---	430			
-3S (C)				0.5	---	---	---	---	417			
-3M				10.0	12.09	13.56	7.71	9.74	736			
-3B				20.0	12.08	13.59	7.72	9.76	730			
C2-4S	1655	61° 16.182'	149° 53.797'	0.5	12.17	13.59	7.55	9.75	356	10	ND (0.010)	<1.8
-4M				12.5	12.10	13.13	7.56	9.77	808			
-4B				25.0	12.11	12.86	7.59	9.77	1172			
C3-1S(A)	1748	61° 14.004'	149° 59.148'	0.5	12.12	14.76	7.67	9.62	669	10	ND (0.010)	2.0
-1S (B)				0.5	---	---	---	---	680	5.0	ND (0.010)	2.0
-1S (C)				0.5	---	---	---	---	680	10	ND (0.010)	<1.8
-1M				8.0	12.10	14.74	7.68	9.59	788			
-1B				16.0	12.08	14.65	7.68	9.51	887			
C3-2S	1802	61° 14.332'	149° 57.419'	0.5	12.09	14.80	7.70	9.62	604	10	ND (0.010)	4.0
-2M				5.5	12.09	14.78	7.69	9.61	771			
-2B				10.5	12.07	14.67	7.69	9.60	796			
C3-3S	1812	61° 14.792'	149° 55.900'	0.5	12.05	14.66	7.70	9.67	572	10	ND (0.010)	<1.8
-3M				14.0	12.06	14.77	7.70	9.64	638			
-3B				27.5	12.04	14.77	7.70	9.53	977 / 822			
C3-4S	1825	61° 15.468'	149° 54.612'	0.5	12.04	14.69	7.71	9.66	577	10 / 10	ND (0.010)	2.0
-4M				19.0	11.94	14.66	7.72	9.68	743			
-4B				38.0	11.89	14.70	7.73	9.71	812			

^a Values from CTD for 0.5 m depth taken as close to surface as possible.

^b Grab samples collected for pH.

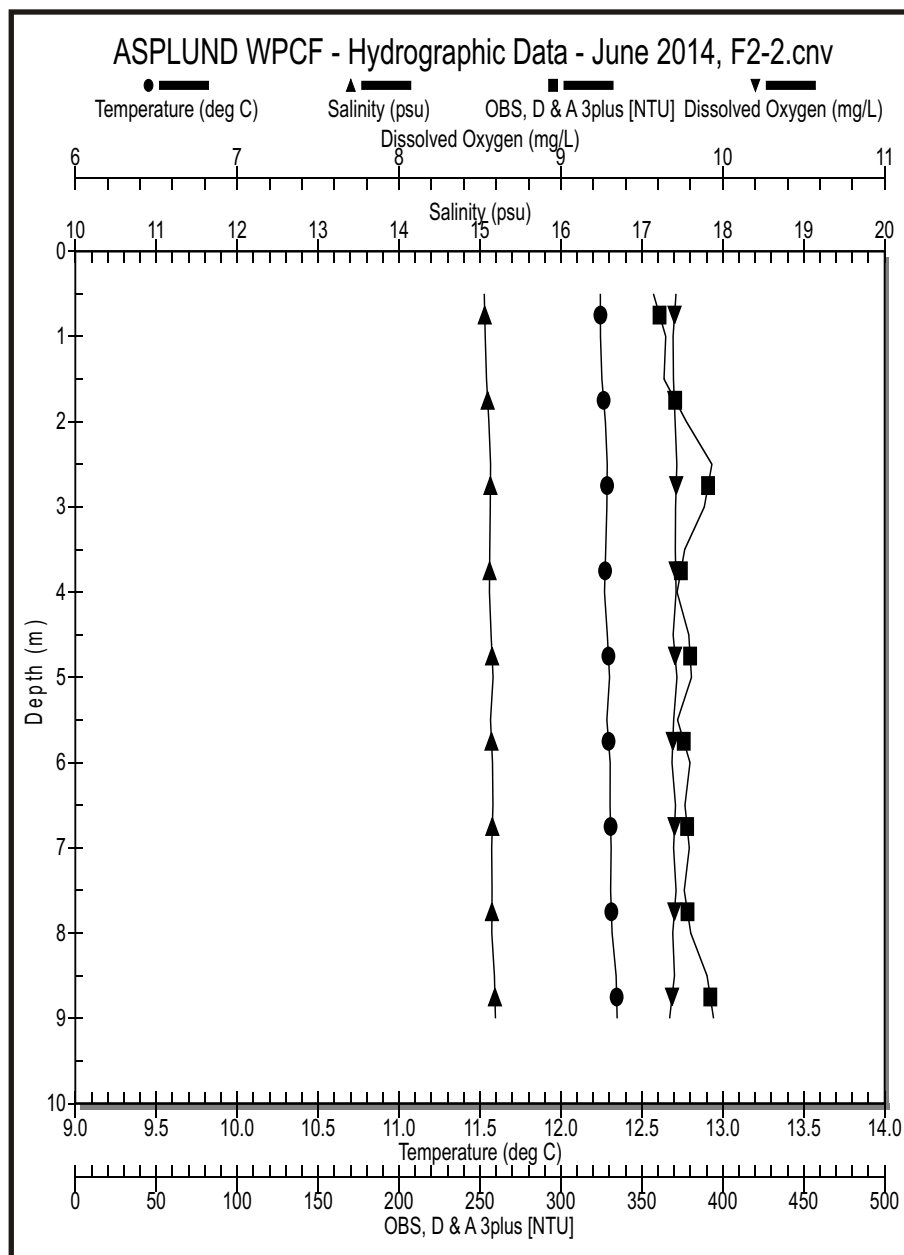
^c Duplicate field or laboratory analyses provided (value / duplicate values).

^d Fecal coliform reported as MPN/100 mL.

--- Samples not collected.

ND Not detected (detection limit).

Outfall Station



Control Station

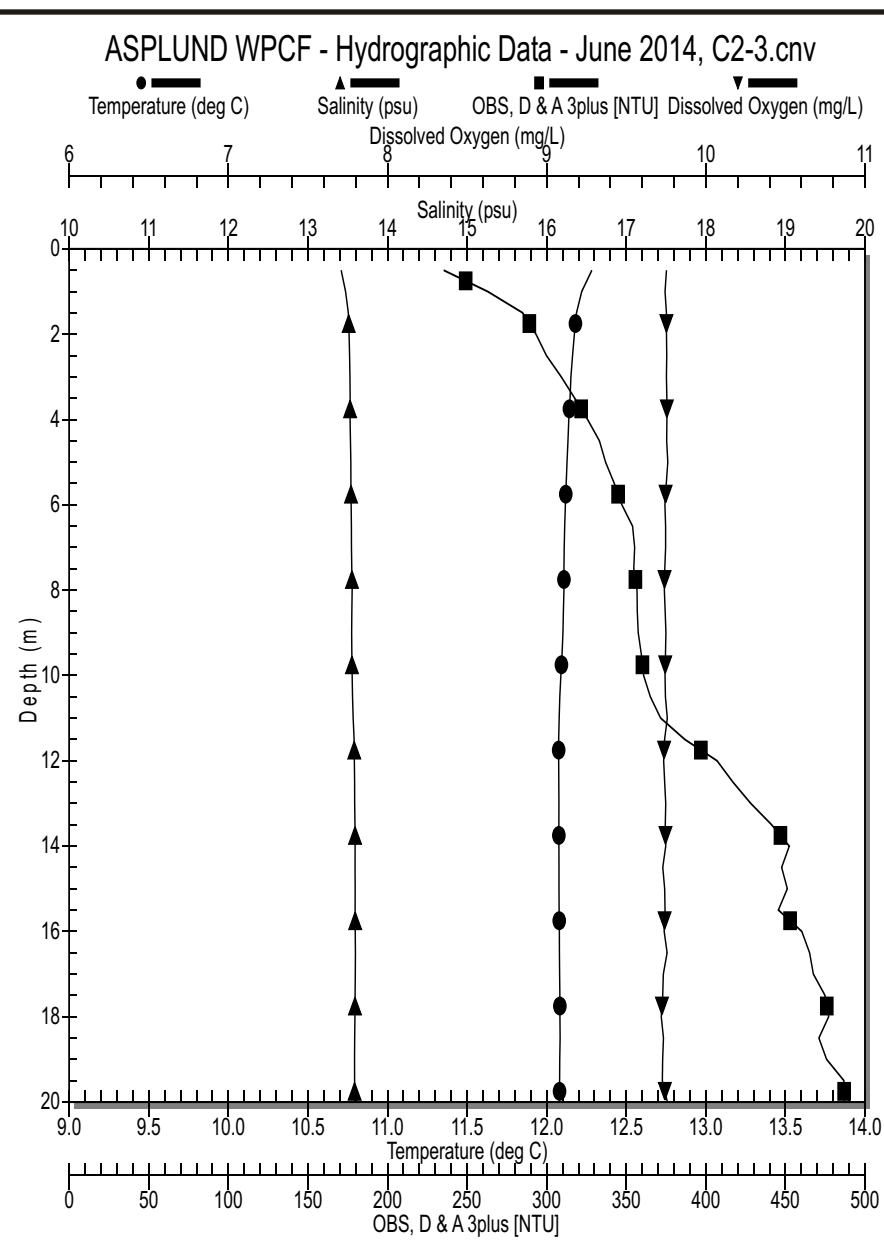


Figure 10. Sample Hydrographic Profiles from Outfall and Control Stations, June 2014.

Fecal coliform values this year were again quite low and ranged from <1.8 to 17 FC/100 mL. Most fecal coliform concentrations were reported as <1.8; this included 21 out of 28 samples at the ebb and flood stations combined and 12 out of 16 samples at the control stations. The overall median for fecal coliform at all of the outfall stations (both ebb and flood) was <1.8 FC/100 mL; the median at the control stations was <1.8 FC/100 mL. Turbidity values for water samples collected during the monitoring ranged from a low of 86 Nephelometric Turbidity Units (NTU) to a high of 1172 NTU with lower values seen near the surface and near slack tide, with generally higher levels overall seen at the control locations.

In addition to routine monitoring conducted at each receiving water quality station, supplemental surface samples were collected at the first three stations (diffuser, ZID boundary, and nearfield) along the first flood drogue trajectory at both the outfall and control sites that represented worst-case low water and low flow conditions. A sample of final effluent was also obtained on the outfall sampling day for comparison. These supplemental samples were analyzed for BETX, polycyclic aromatic hydrocarbons (PAHs), dissolved and total recoverable trace metals, cyanide, and TSS.

The maximum dissolved arsenic, copper, mercury, nickel and zinc concentrations were seen at Station F1-1 located at low slack water above the diffuser, within the ZID (Table 16). The highest dissolved cadmium and lead concentrations were seen at control site stations, C1-1 and C1-2, respectively. The metals chromium and silver were not detected at any location. Copper was found to be higher than the AWQS at one station, F1-1. However this station was located within the mixing zone and not considered a water quality violation. All other dissolved metals concentrations met AWQS at all sample locations including: within the ZID, ZID boundary, near field, and control stations.

Total recoverable metals concentrations were also quite variable with the highest levels for all metals except for mercury seen at the control Station C1-3. The highest mercury level occurred at Station F1-1 at a concentration of 0.0240 µg/L. The high control station results can be directly attributed to higher ambient TSS levels at Station C1-3. Overall, total metal concentration differences seen between the outfall and control locations were not large. Total suspended solid results ranged from 252 to 296 mg/L at the outfall stations compared to 118 to 914 mg/L at the control stations. The effluent sample had a TSS concentration of 46 mg/L.

Cyanide concentrations were below detection limits at all receiving water stations including both the outfall and control locations. The cyanide concentration in the effluent sample collected in conjunction with the receiving water sampling was 1.6 J µg/L which is above the AWQS of 1.0 µg/L but well below the MAEC of 181 µg/L.

Hydrocarbon analyses results are presented in Table 17. Total aromatic hydrocarbons (TAH) defined by the AWQS as BETX (EPA Method 624) was determined by summing benzene, ethylbenzene, toluene, and total xylenes. For values reported as ND, the detection limit was used in the summation. Concentrations of TAH at the water quality stations ranged from ND (<0.257) to 2.02 µg/L, with the highest concentration seen at Station F1-1. Concentrations of TAH were all below the AWQS of 10 µg/L at all stations, including both outfall and control stations. The effluent sample had a TAH concentration of 7.32 µg/L, which is significantly less than the MAEC of 1,810 µg/L.

Table 16. Concentrations of Dissolved Metals, Total Recoverable Metals, Cyanide, and Total Suspended Solids in Receiving Water and Effluent Samples.

Station	Arsenic	Cadmium	Cyanide	Chromium	Copper	Mercury	Nickel	Lead	Silver	Zinc	TSS
	µg/L										mg/L
Dissolved Metals											
F1-1S (WITHIN ZID)	1.70	0.196 J	NA	ND	5.44	0.00196	1.89	ND	ND	14.5	NA
F1-2S (ZID BOUND)	1.52	0.190 J	NA	ND	1.12	0.00157	1.10	ND	ND	3.95 J	NA
F1-3S (NEAR FIELD)	1.51	0.194 J	NA	ND	1.11	0.00108	1.12	ND	ND	4.20 J	NA
C1-1S (CONTROL)	1.55	0.272 J	NA	ND	2.32	0.00126	1.25	ND	ND	12.8	NA
C1-2S (CONTROL)	1.57	0.193 J	NA	ND	1.44	0.000824	1.14	0.407	ND	4.49 J	NA
C1-3S (CONTROL)	1.65	0.191 J	NA	ND	1.12	NT	1.18	ND	ND	4.07 J	NA
EFFLUENT	1.89	0.122 J	NA	ND	9.95	0.00705	3.94	0.339	ND	45.8	NA
REPORTING LIMIT	0.0300	0.300	NA	5.00	0.300	0.000500	0.500	0.300	0.500	5.00	NA
Total Metals											
F1-1S (WITHIN ZID)	5.73	0.651 J	ND	ND	26.9	0.0240	11.9	3.24	ND	70.2	252
F1-2S (ZID BOUND)	8.86	0.653 J	ND	9.11 J	34.9	0.0209	18.0	4.87	ND	71.1	296
F1-3S (NEAR FIELD)	6.35	0.627 J	ND	ND	23.3	0.0167	12.1	3.65	ND	47.9	262
C1-1S (CONTROL)	3.40	0.618 J	ND	ND	11.3	0.00672	6.65	1.82	ND	37.3	150
C1-2S (CONTROL) ^a	4.12	0.617 J	ND/ND	ND	14.4	0.0122	7.88	1.95	ND	39.6	124 / 118
C1-3S (CONTROL)	14.6	0.705 J	ND	19.2 J	58.8	NT	31.6	8.84	ND	96.0	914
EFFLUENT	2.23	0.648 J	1.6 J	ND	30.7	0.0199	5.66	1.41 J	ND	101	46
REPORTING LIMIT	0.0300	1.50	4.7	25.0	1.50	0.000500	2.50	1.50	2.50	25.0	NA

^a Field sample value / field duplicate.

ND Not detected.

J

NT

Result is an estimated value between MDL and MRL.

Not tested; sample broke in shipment.

NA

Not applicable / not available.

Table 17. Supplemental Receiving Water and Effluent Hydrocarbon Analyses.

Parameter	Control Flood Samples			ZID Flood Samples			Effluent
	C1-1S	C1-2S	C1-3S	F1-1S	F1-2S	F1-3S	
Volatile Organics (EPA 602 list by EPA 624 method) in µg/L							
Benzene	<0.031	<0.031	<0.031	0.11 J	0.050 J / <0.031	0.040 J	0.14 J
Toluene	0.070 J	0.10 J	<0.032	1.4	0.27 J / 0.20 J	0.25 J	5.8
Ethylbenzene	<0.030	<0.030	<0.030	0.090 J	0.030 J / <0.030	0.030 J	0.29 J
Xylenes (Total)	<0.164	<0.164	<0.164	0.42 J	<0.17 / <0.17	<0.17	1.09 J
TAH (as BETX)	<0.295	<0.325	<0.257	2.02	<0.52 / <0.431	<0.49	7.32
Polynuclear Aromatic Hydrocarbons (PAH) by GC/MS in µg/L							
TPAH	0.0293	0.0293	0.0744	0.401	0.0444	0.0403	2.498
Total Aqueous Hydrocarbons (TAqH) in µg/L							
TAqH ^a	<0.324	<0.354	<0.331	2.42	<0.56 / <0.48	<0.53	9.82

^a Defined by the State of Alaska as BETX analytes plus PAH analytes from EPA Method 610 analysis; these calculated values include the full suite of PAH analytes measured by TDI Brooks.

J The result is an estimated value.

< Below method detection limit for individual analytes or for summations where one or more analytes was ND.

All concentrations of individual PAHs were summed and reported as total PAHs (TPAH) in Table 17. TPAH concentrations were low at both control and outfall stations. The TPAH values ranged from 0.0293 to 0.0744 µg/L at the control stations and from 0.0403 to 0.401 µg/L at the outfall stations. The TPAH concentration measured in the effluent sample was 2.498 µg/L. Total aqueous hydrocarbons (TAqH) as determined by the summation PAHs plus BETX were calculated for the six stations and effluent (Table 17). Concentrations of TAqH were below the AWQS of 15 µg/L at all stations, including both outfall and control stations. Control stations ranged in TAqH from <0.324 to <0.354 µg/L, while outfall station TAqH concentrations ranged from <0.48 to 2.42 µg/L. The concentration of TAqH in the effluent was estimated at 9.82 µg/L, compared to the MAEC of 2,715 µg/L and the AWQS of 15 µg/L.

3.2.2 Intertidal Zone and Stream Bacterial Sampling

Intertidal zone and stream bacteriological sampling was performed on 11 June 2014 (Table 18). Refer to Figure 3 for a map of the intertidal station locations and

Figure 11 for stream locations. Intertidal sampling began approximately 2 hrs prior to high tide at 17:39 ADT and was completed at 18:01 ADT. Two replicates were taken at all intertidal stations. Stream sampling was conducted from 10:43 to 11:14 ADT on 11 June 2014. All stream samples were collected above any tidal influence so as to represent only stream inputs. In addition, an effluent sample was collected at the plant on this date for fecal coliform analysis.

Table 18. Summary of Bacterial Analyses, 11 June 2014.

Station and Replicate	Sample Time (ADT)	Fecal Coliform MPN/100 mL
IT-1 Replicate 1	17:39	<1.8
IT-1 Replicate 2	17:39	1.8
IT-2 Replicate 1	17:46	<1.8
IT-2 Replicate 2	17:46	<1.8
IT-3 Replicate 1	17:48	<1.8
IT-3 Replicate 2	17:48	1.8
IT-4 Replicate 1	17:52	4.5
IT-4 Replicate 2	17:52	4.5
IT-5 Replicate 1	17:55	<1.8
IT-5 Replicate 2	17:55	<1.8
IT-6 Replicate 1	17:56	<1.8
IT-6 Replicate 2	17:56	<1.8
IT-7 Replicate 1	18:01	<1.8
IT-7 Replicate 2	18:01	<1.8
IT-C Replicate 1	17:58	<1.8
IT-C Replicate 2	17:58	2.0
Effluent Replicate 1	NA	79
Effluent Replicate 2	NA	79
Fish Creek Replicate 1	11:14	790
Fish Creek Replicate 2	11:14	790
Chester Creek Replicate 1	10:58	33
Chester Creek Replicate 2	10:58	33
Ship Creek Replicate 1	10:43	49
Ship Creek Replicate 2	10:43	17

NA Not available

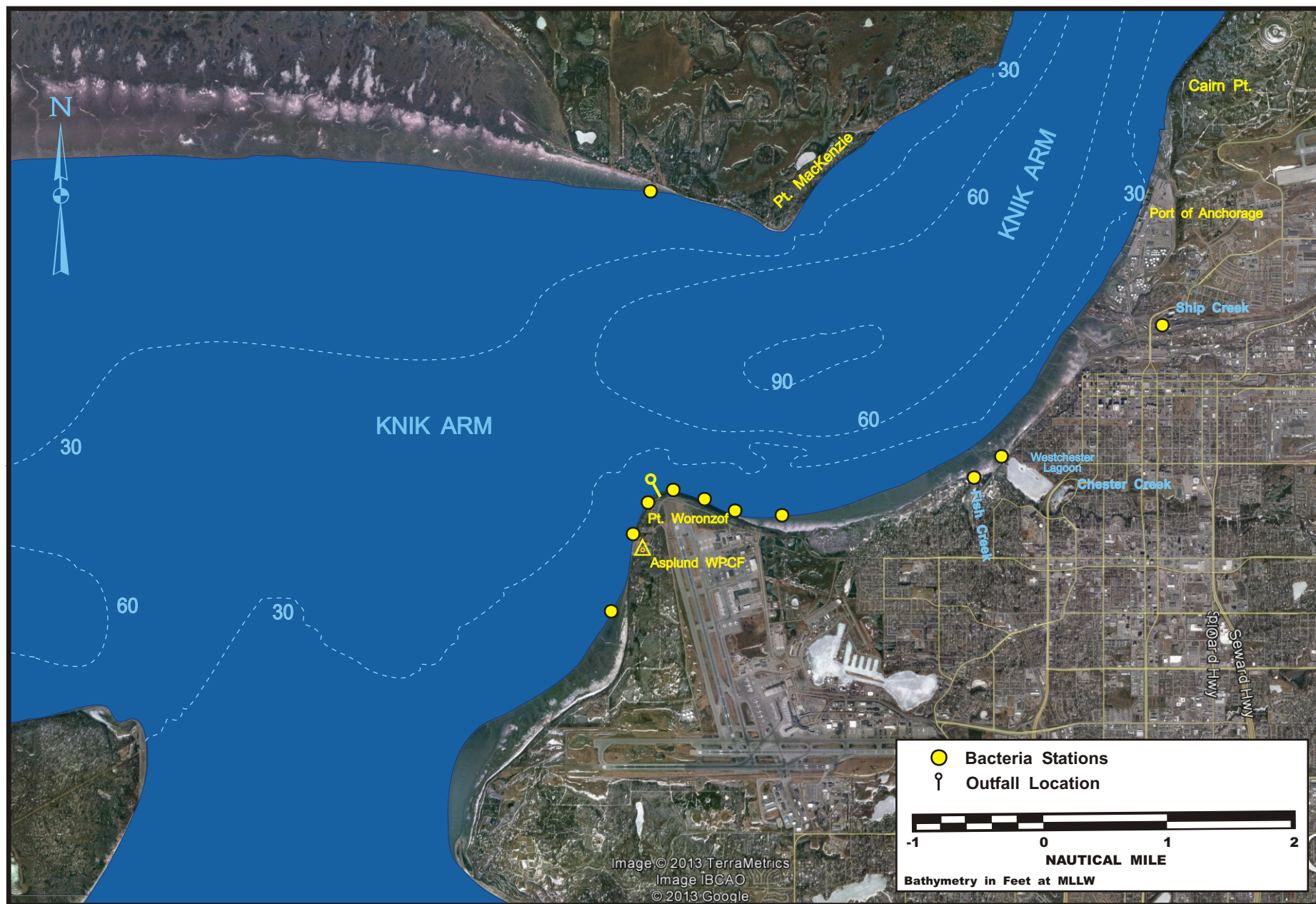


Figure 11. Stream and Intertidal Fecal Coliform Bacteria Sampling Locations.

Fecal coliform concentrations found in Fish, Chester, and Ship Creeks, which were sampled prior to the creeks entering Knik Arm, ranged from a low 17 FC/100 mL in the second replicate at Ship Creek to a high of 790 FC/100 in the replicates collected from Fish Creek. The plant effluent sample taken on the same day showed a fecal concentration of 79 FC/100 mL. Fecal coliform concentrations at the intertidal stations were low again this year and ranged from < 1.8 to 4.5 FC/100 mL. The highest intertidal fecal concentrations (4.5 FC/100 mL) were seen in the replicates at Station IT-4, 250 m east of the diffuser. Overall, the intertidal fecal coliform bacteria levels were again found to be very low at all locations in 2014.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

4.1 OBJECTIVES

The monitoring program includes a comprehensive quality assurance/quality control (QA/QC) component that encompasses all aspects of the monitoring program, from initial sample collection and field observation recording through laboratory analysis and data analysis to reporting. The objectives of the QA/QC program were to fully document the field and laboratory data collected, to maintain and document data quality, and to ensure that the data collected are accurate, representative, and complete and are comparable with data collected through other EPA-regulated NPDES programs. The monitoring program was designed to allow the data to be assessed by the following parameters:

- Precision
- Accuracy
- Comparability
- Representativeness
- Completeness

Precision is a measure of agreement among repeated measurements of the same property which was assessed through duplicate and triplicate sampling and analysis. Accuracy is a measure of the overall agreement of a measurement to a known value and includes a combination of random error (precision) and systematic error (bias) that are due to sampling and analytical operations. For this monitoring program, these were assessed in the field by comparing field instrumentation to known standards and in the laboratory by running standard reference material, performing blank spikes, matrix spikes, and comparing instrumentation performance to calibration standards. Comparability is a measure of the confidence with which one data set or method can be compared to another which was assured by utilizing standard EPA and other accepted sampling and laboratory protocols that could be traced back to known standards and using standard units of measure, such as navigational information that could be traced back to a known datum. Representativeness is the measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. This was assessed by determining sampling variability at a location by repeated sampling that then could be compared to laboratory variability. Completeness is a measure of the amount of valid data obtained that can then be compared to the amount of anticipated data as outlined in the project workplan.

These parameters were controlled by adhering to EPA approved and documented methods and procedures, by the analysis of quality control (QC) samples on a routine basis, the use of contract laboratories with existing QA/QC plans, accepted and defined data review and verification procedures, and comprehensive sample documentation procedures. Throughout the monitoring program, KLI coordinated with the subcontracting laboratories to ensure that their in-house QA/QC programs were being implemented to meet the required standards.

Quality control activities in the field included adherence to documented procedures, including those in the monitoring program workplan, and the comprehensive documentation of sample collection and sample identification information. Sample integrity and identification were ensured by rigidly-enforced chain of custody (COC) procedures. The COC procedures

document the handling of each sample from the time the sample was collected to the arrival of the sample at the laboratory.

Analytical methods in use throughout the monitoring program have been approved and documented by EPA. These methods were used as project-specific protocols to document and guide analytical procedures. Adherence to these documented procedures ensures that analytical results are properly obtained and reported.

4.2 FIELD QUALITY CONTROL

Quality control activities in the field consisted of the following:

- adherence to approved and documented procedures in the monitoring program workplan
- cross-checking of field identifications, measurements, and recording to ensure consistency, accuracy, and completeness of field sampling log forms.
- comprehensive documentation of field observations, sample collection and identification information, and navigation and drogue position information.

Sampling procedures utilized for this project have been successfully used for a number of years on the Asplund WPCF monitoring program. The use of documented and well-known procedures provides for greater likelihood of obtaining environmental samples uncontaminated by sampling procedures or apparatus. The use of project-specific field forms and data entry sheets also provide guidance to assure completeness and accuracy of field data. Adherence to these procedures and use of these project specific documents helped ensure that data collected over the course of the project were complete, comparable, and accurate, and that the study results are representative of conditions existing at the sampling sites.

4.2.1 Documentation

For observations made in the field, cross-checking between personnel was used as the primary method of quality control. These included, for example, review of navigational information recorded on the drogue field log. As described in Section 2.5, sample documentation began in the field using pre-printed log forms, labels, COC forms, and pre-determined sample identification numbers that were designed specifically for use on this project. This extensive field documentation provided a paper trail that exists for each sample or field observation and ensures credibility of the data. All field records were reviewed by the field crew leader as soon as possible after sampling was completed. After review and verification, field logs were copied, electronically scanned, and filed at the KLI Anchorage office upon return from the survey. Electronic backup copies of all field forms and other data were also made and a complete copy of these records has also been included in the Appendices of this report.

Sample integrity and identification were ensured by the COC program. The COC procedures documented the handling of a sample from the time the sample was collected to the receipt of the sample at the analytical laboratory. At the time of shipment, the field personnel kept a copy of the completed COC form, and the original accompanied the samples to the laboratory. Upon arrival and completion of the COC at the laboratory, a copy of the final signed COC was returned to KLI for documentation.

4.2.2 Sample Handling

Samples were frozen, chilled, and/or preserved as required by the appropriate methods in the field and until receipt at the laboratory. Samples were packed in coolers along with the completed COC forms for shipment to analytical facilities as described in Section 2.0. Coolers were securely packed with ice packs as required and custody sealed with signed and dated tamper evident tape for shipment. Upon receipt by the laboratory the condition of the samples were noted on the COC form including: cooler temperature, broken or missing samples, etc.

4.2.3 Navigation

As described previously, navigation was accomplished with a differential global positioning system (DGPS). The accuracy of the DGPS coordinates were verified by positioning the vessel over the diffuser during a low slack tide when the outfall discharge was evident and comparing DGPS readings with the known outfall location. Historical intertidal stations were re-acquired using a hand-held DGPS, distance and bearings, and visual sightings to known landmarks. All station information was entered on the appropriate field logs and reviewed by the field leader.

4.2.4 Field Instrumentation

Field equipment used for collection, measurement, and testing was subject to a strict program of control, calibration, adjustment, and maintenance. Care was taken to ensure that the instruments used for field measurements of temperature, salinity, DO, and pH were calibrated and checked with appropriate standards prior to and after each sampling event. The standards of calibration are in accordance with applicable criteria such as the U.S. Bureau of Standards, American Society for Testing and Materials (ASTM) Standards or National Institute of Standards and Technology (NIST), and follow the instrumentation manufacturer's recommended procedures.

Temperature calibration was ensured by pre-calibration at the factory with calibration checks of the electronic temperature sensor against a research grade NIST traceable thermometer. The electronic sensor for salinity (conductivity) was also pre-calibrated at the factory and checked in the field against a second calibrated field probe and against a secondary conductivity standard. The DO probe was also pre-calibrated at the factory and field checked by comparison to saturated seawater. For pH, the YSI 552 multi-probe was pre-calibrated using three known buffer solutions and checked in the field with a secondary pH calibration standard.

4.2.5 Sampling Variability

Sampling variability was documented by sampling three replicates at one station for the water quality parameters. This included three replicate grabs at the surface for fecal coliform, color, TRC, and turbidity analyses. In addition, triplicate casts of the CTD for DO, temperature, and salinity were performed at one station in order to check reading variability from the probe's electronic sensors. For pH, the YSI meter was utilized to obtain three separate field readings. This field sampling variability check was performed to show the natural variability of the receiving water which could then be compared to laboratory variability.

4.2.6 Field Check Samples

Field check samples include trip blanks for volatile organic analyses for EPA Method 624, field blanks, field generated duplicates, standard reference materials (SRMs), or other samples of known concentration that may be sent to the laboratory. With the exception of the trip blanks which are initiated at the laboratory, field blanks and field duplicates samples were sent to the laboratory as blind samples to ensure unbiased reporting of results.

4.3 LABORATORY QUALITY CONTROL

Analytical quality control for this project included the following:

- adherence to documented and approved procedures, including EPA, Standard Methods, etc., internal laboratory protocols, and respective laboratory QA/QC programs
- calibration and verification of analytical instruments
- ability of each analytical laboratory to meet analytical precision, accuracy, limits of detection, and limits of quantification that meet EPA requirements
- use of quality control samples, internal standards, and surrogate solutions

The analytical laboratories used on this project operate under the quality assurance (QA) programs described in their QA management plans. These programs involve the participation of qualified and trained personnel; the use of standard operating procedures for analytical methodology and procedures; a rigorous system of documenting and validating measurements; maintenance and calibration of instruments; and the analysis of quality control samples for precision and accuracy tracking. The pertinent methods' descriptions the laboratories are following are comprehensive and provide information concerning proper sample collection, receipt and login, processing, storage, and preservation; required apparatus and materials; analytical procedure; standardization and calibration techniques; quality control samples required; methods of calculating values and assessing data quality; and reporting and performance criteria.

4.3.1 Documentation

Documentation in the laboratory included signing the original COC forms, documenting sample condition upon receipt, and generating the internal documents that track samples through the laboratory (e.g., sample control logs, refrigerator logs, etc.). Any deviations from the prescribed methods or internal laboratory standard operating procedures (SOPs) were documented by the laboratory and included in a case narrative with the analysis report. Data affected by such deviations were appropriately qualified by the laboratory, as was any data that did not meet acceptable quality criteria. Typical data qualifiers included those denoting estimated concentrations (J), not detected (ND or U), method blank contamination (B), and matrix interference (i). A full list of potential data qualifiers is included with the laboratory data reports in the Appendices, and any data that were qualified by the laboratory were also qualified where applicable in the data tables in this report.

4.3.2 Calibration

Calibration is an integral part of any instrumental analysis. Calibration requirements for each type of analysis to be used on this monitoring project are described in the appropriate methods. Typically, instrument calibration was performed daily or on a per batch basis as required by the laboratory method.

4.3.3 Quality Control Procedures

Internal laboratory quality control checks included the use of surrogate solutions and quality control samples such as procedural (or method) blanks, matrix spike/matrix spike duplicates (MS/MSD), standard reference materials (SRMs), method required QC check samples, and duplicates as specified in the EPA approved analytical procedures. In addition, contract laboratories took part in EPA's annual Discharge Monitoring Report - Quality Assurance Study programs to verify accuracy of their data. Surrogate compounds were spiked into samples as appropriate to assess individual sample matrix effects on sample analysis. This included QC samples such as procedural blanks and matrix spike samples. Surrogate compound analyses were reported in percent recovery. Whenever possible, QC samples such as MS/MSD have been run on samples from this program, however in some cases where insufficient volume existed the laboratories have performed standard batch QC. Results from quality control samples allowed the laboratory to assess quality assurance parameters such as accuracy and precision of the data. Any data falling outside the acceptable criteria as defined in the methods were appropriately investigated by the laboratory, qualified, and described in the case narrative.

Method blanks are pure, organic- and/or metal-free reagent water that are run through the analysis process and used to verify that analyte concentrations are accurate and do not reflect contamination. Method blanks were analyzed as called for by each method, typically one per sample batch.

Laboratory accuracy was assessed by routine spiking of environmental samples with a standard addition as called for by the appropriate method. These MS/MSD were run on the organic analyses collected as part of both the in-plant and receiving water monitoring components of the program. These spike samples are fortified with components of interest as required by the method following the initial analysis to check the ability of the method to recover acceptable levels and to determine accuracy of the data. Quality control charts are prepared and maintained by the laboratories where applicable to show the range of individual measurements encountered by following standard EPA procedures such as those outlined in EPA method guidance documents or in *Design of 301(h) Monitoring Programs for Municipal Wastewater Discharges to Marine Waters* (EPA, 1982b) and other guidance documents (e.g. EPA, 1994a and 1994b).

Trace metals analyses for the monitoring were supported through the use of certified standard reference materials (SRMs), which are quality control reference materials with known metals values that are obtained from the National Bureau of Standards and other sources. These SRMs were analyzed by the laboratory at the same time as the program samples in order to ensure laboratory accuracy. Results of the analyses of SRMs should fall within acceptable limits and can be expressed as percent recovery.

For receiving water quality samples, analytical and instrument variability were checked with field and laboratory splits of larger-volume samples into triplicates and analyzing the subsamples

for the various water quality parameters that included color, fecal coliform, TRC, and turbidity. The individual measurements and concentration ranges were reported for each parameter of each split. In addition, duplicate analyses of samples split in the laboratory were used as a means to assess laboratory precision.

For other water quality parameters, the following summary of QA/QC procedures apply:

- **Color:** Fresh color standards were made prior to the beginning of the program. Samples were allowed to settle and decanted in the field and either pre-treated with paper filtration or centrifuged to remove turbidity and reported as "true color."
- **Turbidity:** The instrument was calibrated with a series of standards provided by the manufacturer. Due to the high turbidity in Cook Inlet, calibration samples included high range standards to ensure that the measured turbidities were within the range of the instrumentation calibration. In addition, select field samples were run in duplicate.
- **Total Residual Chlorine:** TRC was quantified with an ion selective electrode probe (SM 4500 Cl-I) which requires a blank, blank spikes, and a series of laboratory calibration standards. To account for seawater matrix interference issues, the method blank and calibration standards were prepared with Cook Inlet background seawater.
- **pH:** Measurements of pH were made with a YSI 552 multi-probe system that was precalibrated with three pH standards (4, 7, and 10 pH units) and checked in the field against a secondary pH standard solution.
- **Hydrographic CTD:** Sensors are factory calibrated and then field checked with either a refractometer or secondary salinometer for conductivity, research grade NIST traceable thermometer or secondary probe system for temperature, and saturated water or secondary probe for dissolved oxygen.

4.3.4 Method Detection Limits

Depending on each laboratory's adopted terminology, the method detection limits (MDLs), practical quantitation limits (PQLs), or method reporting limits (MRLs) for the various analytes were determined using the appropriate method as described in the EPA methods for a particular analysis. These MDLs, PQLs, and MRLs were reported with the data (see appendices) and are included in summary data tables as appropriate. Concentrations below the MDL were typically qualified with either a "U" or "ND" code for not detect or "J" when reported as an estimated value that was above the MDL and below the MRL or PQL.

4.4 DATA REVIEW AND VALIDATION

Data were verified by performing comparisons of final data against the original documentation, including the workplan, field logs and data sheets, and analytical reports. Any discrepancies were fully documented in the program files and described where necessary in the annual report. Data were validated according to accuracy, precision, and completeness for both the field sample collection and analytical laboratory components of the program. Qualitative evaluation and statistical procedures were used to check the quality of the field and chemical data as

appropriate. The primary goals of these review and validation procedures are to ensure that the data:

- are representative of conditions in the study area
- are accurate
- demonstrate the required level of precision
- are comparable with data from other NPDES programs
- are acceptable for use as a tool to evaluate permit compliance
- are useful in applying for reauthorization and renewal of 301(h) variance
- allow independent technical appraisal of the program's ability to meet the monitoring program objectives.

Analytical data were subjected to review upon receipt from the laboratory following guidelines such as those published in *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 1994a), or *U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA, 1994b). Items reviewed during data validation included sample holding times, results for laboratory method blank (MB), MS/MSD, check standards or SRMs, field and laboratory duplicates, field and trip blanks, report completeness, and laboratory performance (i.e., ability to achieve method detection limits and adherence to QA/QC criteria established for this program). Items failing to meet such validation and review procedures were noted and corrected, if possible. Items that could not be corrected and fell outside of acceptable limits (e.g., a sample analyzed outside holding time) have been noted in data tables and in the appendices of this annual report when they occurred. For example, if a matrix interference was noted by the laboratory in their analysis of the influent and effluent samples, it would be appropriately qualified in the data tables, and addressed by the laboratory in their case narrative on how or whether it impacted the data quality.

4.5 QUALITY ASSURANCE/QUALITY CONTROL RESULTS

4.5.1 Field Instrumentation and Sampling Quality Control Results

For influent, effluent, and sludge monitoring, field-generated duplicate effluent samples were collected for the analysis of enterococci bacteria during both the June and August 2014 sampling. Results for these duplicate analyses are provided in Table 9 and Table 10, and the appendices, and were found to be acceptable. Results from duplicate field samples collected for certain parameters during the receiving water sampling such as volatile organics, cyanide, turbidity, and TSS are reported in the appropriate tables (Table 15, Table 16, and Table 17), and were found to be within acceptance limits. Results of field and laboratory triplicate analyses are presented in Table 19.

Field blanks (FB) were collected for several parameters during each sampling event by pouring HPLC-grade deionized (DI) water into the appropriate sampling containers with the correct preservative. Trip blanks (TB) consisted of DI blank samples prepared at the laboratory that went through the same shipping and handling procedures as all the other sample containers of each analytical type; these remained unopened in the field. Field blanks, trip blanks, and method blanks (MB) were analyzed using EPA Method 624 for volatile constituents. A number of the FBs, TBs, or MBs that were analyzed in conjunction with either summer-dry or summer-

Table 19. Sampling and Laboratory Variability for Water Quality Samples, 11 and 12 June 2014.

Station	Subsample Designation	Fecal Coliform* (MPN/100 mL)	Color (units)	Turbidity (NTU)	TRC (mg/L)
SAMPLING VARIABILITY					
C2-2S	A	< 1.8 [<1-10]	15	431	<0.010
Turbidity from C2-3S	B	< 1.8 [<1-10]	10	430	<0.010
	C	< 1.8 [<1-10]	5	417	<0.010
Mean	---	< 1.8	10	426	<0.010
Standard Deviation	---	0	5	7.8	0
Coefficient of Variation (%)	---	0	50	1.8	0
LABORATORY VARIABILITY					
C3-1S	A	2.0 [0.10-10]	10	669	<0.010
	B	2.0 [0.10-10]	5	680	<0.010
	C	< 1.8 [<1-10]	10	680	<0.010
Mean	---	1.93	8.3	676.3	<0.010
Standard Deviation	---	0.12	2.9	6.4	0
Coefficient of Variation (%)	---	6.2	34.9	0.95	0
TURBIDITY DUPLICATE ANALYSES					
Station	Rep A	Rep B	Relative % Difference		
E1-4S	368	350	5.0		
E2-3M	540	553	2.4		
E3-2B	704	722	2.5		
F1-4M	220	225	2.2		
F2-3S	507	527	3.9		
F3-3S	456	470	3.0		
C1-3M	619	682	9.7		
C2-1B	516	528	2.3		
C3-3B	977	822	17.2		
COLOR DUPLICATE ANALYSES					
E3-2S	10	10	0		
F2-4S	ND (5)	ND (5)	0		
F3-4S	ND (5)	ND (5)	0		
C2-2S (C)	5.0	5.0	0		
C3-4S	10	10	0		

* 95% confidence intervals indicated in brackets (American Public Health Association, 1998. *Standard Methods for the Examination of Water and Wastewater*. 20th Edition. Washington, D.C. Table 9221.IV. supplemental).

--- Not applicable / not calculated.

ND Not detected (detection limit).

wet sampling did show estimated (J) trace levels of target analytes above their MDLs. Since none of the concentrations were above their MRLs, the laboratory did not qualify the data, and no further corrective action was taken.

Sampling variability for water quality parameters (color, fecal coliform, TRC, and turbidity) was determined by analyzing three discrete surface samples taken at either Station C2-2 or C2-3 (Table 19). Where appropriate, the mean, standard deviation, and coefficient of variation are included in Table 19 to provide a measure of variability for parameters. The coefficient of variation for the various sample types was found to be 0% for fecal coliform, 50% for color, 0% for TRC, and 1.8% for turbidity. Color was found to be the most variable with individual concentrations of 5, 10, and 15 color units.

Variability and calibration checks of the electronics probe were done by performing repeated profiles of temperature, salinity, and DO at one station (C2-2). Results of these variability checks for the Seabird CTD show that probe variability for temperature, salinity, and DO was extremely low in all cases with a maximum coefficient of variation of 0.31%; seen in salinity, with lower variability seen for temperature and DO (Table 20). In addition, sensors were checked in the field against a second multi-probe system that had been calibrated immediately prior to field deployment. The temperature, salinity, and DO probes were found to be accurate and within calibration during the survey. A post-cruise factory calibration of the SeaBird CTD was also performed that indicated that all sensors were within the manufacturers expected calibration range.

4.5.2 Laboratory Quality Control Results

Full analytical data and laboratory case narratives are provided by the laboratories and are included in the appendices. Laboratory duplicate analyses, where performed, were found to have a high degree of precision and were within the acceptance criteria for relative percent difference (RPD). Laboratory duplicates were performed for a number of organic analyses and were found to be within acceptance limits.

In addition to the standard laboratory QC procedures, color, fecal coliform, TRC, and turbidity samples collected at Station C3-1 during the receiving water sampling were either split in the laboratory (fecal coliform and turbidity) or in the field (color and TRC) and analyzed in triplicate. Mean, standard deviation, and coefficient of variation are reported in Table 19 for these samples. Coefficient of variation was shown to be 6.2% for fecal coliform, 34.9% for color, 0.0% for TRC, and 0.95% for turbidity. For analyses where samples were run in duplicate, such as color and turbidity, the relative percent difference between duplicates was calculated. The RPDs for laboratory duplicate analyses were found to generally be very low and within acceptable limits. Duplicate results for turbidity ranged from 2.2 to 17.2% RPD. Color samples were collected and run as laboratory duplicates on five samples with 0% RPD for all five duplicates.

Laboratory accuracy was assessed through the use of surrogate recoveries, sample and control spikes and duplicates, and SRMs. Detailed QA/QC results for all contract laboratory analyses are provided in the appendices corresponding to each analysis. Surrogates are compounds that were added to each sample and QC sample that were analyzed by gas chromatography (GC) methodology, such as volatile organic compounds (EPA 624/8260C), semi-volatile organic

Table 20. Seabird SEACAT SBE-19 CTD Probe Variability Check, 12 June 2014.

Depth (m)	Temperature (°C)			Salinity (ppt)			DO (mg/L)			Mean (units)			Standard Deviation			Coeff. of Variation (%)		
C2-	2A	2B	2C	2A	2B	2C	2A	2B	2C	Temp	Sal	DO	Temp	Sal	DO	Temp	Sal	DO
0.5	12.31	12.31	12.29	13.31	13.32	13.37	9.75	9.74	9.74	9.74	13.34	9.74	0.008	0.032	0.009	0.08	0.24	0.09
1.0	12.30	12.29	12.27	13.32	13.36	13.40	9.73	9.73	9.73	9.73	13.36	9.73	0.014	0.042	0.001	0.15	0.31	0.01
1.5	12.29	12.28	12.26	13.33	13.38	13.41	9.73	9.74	9.74	9.74	13.38	9.74	0.015	0.041	0.008	0.15	0.31	0.08
2.0	12.29	12.27	12.26	13.35	13.39	13.42	9.73	9.73	9.74	9.74	13.39	9.73	0.015	0.037	0.004	0.16	0.28	0.04
2.5	12.28	12.27	12.25	13.37	13.40	13.43	9.73	9.74	9.74	9.74	13.40	9.74	0.015	0.031	0.007	0.16	0.23	0.08
3.0	12.28	12.27	12.25	13.38	13.40	13.43	9.69	9.75	9.74	9.74	13.40	9.73	0.016	0.028	0.031	0.16	0.21	0.32
3.5	12.28	12.26	12.25	13.39	13.41	13.43	9.71	9.75	9.75	9.75	13.41	9.74	0.015	0.022	0.021	0.15	0.16	0.22
4.0	12.27	12.26	12.25	13.40	13.41	13.43	9.73	9.74	9.75	9.75	13.41	9.74	0.011	0.019	0.011	0.11	0.14	0.11
4.5	12.26	12.25	12.24	13.40	13.42	13.43	9.75	9.74	9.75	9.75	13.42	9.75	0.010	0.017	0.005	0.10	0.12	0.05
5.0	12.26	12.25	12.24	13.40	13.41	13.42	9.75	9.73	9.75	9.75	13.41	9.75	0.012	0.013	0.010	0.12	0.10	0.10
5.5	12.26	12.25	12.24	13.39	13.41	13.41	9.75	9.73	9.74	9.74	13.40	9.74	0.010	0.010	0.008	0.10	0.07	0.08

compounds (EPA 625/8270D), pesticides (EPA 8081B, 8082A and 8141A/B), and dioxins (EPA 8290). Some instances of surrogate recoveries outside QC recovery limits were found during the 2014 influent, effluent, and sludge monitoring effort. These deviations are discussed in the case narratives that were provided by each laboratory which fully detail all QC issues for both sampling events and explain any QC deviations; these are provided in the appendices. As indicated by the laboratories, in all instances the data were not significantly affected by any QC issue and deviations did not affect the usability of the laboratory data. Most of the deviations were ascribed to matrix interference issues.

Matrix spike (MS), matrix spike duplicate (MSD), laboratory control spike (LCS), and duplicate control spike (DCS) are samples and blanks that are spiked with target compounds of interest to determine percent recovery and relative percent difference between duplicates. Whenever possible, MS/MSD samples were run on samples from this program, however in some cases where insufficient volume existed, the laboratories performed standard batch QC. The QC criteria as specified in the EPA protocol include an acceptable recovery range and an RPD that should not be exceeded. Total metals, dissolved metals, cyanide, volatile organic compounds, and semi-volatile organic compounds met QC criteria for MS, MSD, LCS, and DCS with few exceptions for all analyses on the program. Other than one deviation for antimony, no deviations were found in the QC data that affected the overall quality of the data reported for the monitoring program. Detailed case narratives were provided by each laboratory which fully detail all QC issues for both sampling events and explain any QC deviations; these are provided in the Appendices.

One sludge result for total antimony during the August summer-wet toxic pollutant and pesticide sampling was flagged with an “N”, indicating that the matrix spike recovery was not within control limits (refer to Table 10). The laboratory narrative indicated that antimony recoveries are generally low for soil and sediment samples when digested using EPA 3050B and that the concentration should be considered an estimated concentration that is biased low.

Trace metals analyses for the receiving water testing were supported through the use of SRMs, which are quality control reference materials with known metals values that are obtained from the National Bureau of Standards, National Institute of Standards and Technology, or other certified standards. These SRMs were analyzed by the laboratories at the same time as the project samples in order to ensure laboratory accuracy. Results of the analyses of SRMs should fall within acceptable limits and can be expressed as percent recovery. All metals SRM results were within acceptance limits (Appendix C4).

Method blanks (or procedural blanks) were also analyzed for all analyses where required and appropriate for the monitoring program. Method blanks consist of pure, organic- or metal-free reagent grade water that is run through the analysis process and used to verify that analyte concentrations are accurate and do not reflect contamination. For the volatile and semi-volatile organic analyses, no analytes were detected in the method blanks above their MRLs in any of the summer-dry or summer-wet laboratory reports.

For the 2014 receiving water monitoring, no analytes were detected in the MBs for cyanide or BETX. PAH analyses of MBs did yield trace quantities of target compounds but at levels <3X the MDL and thus required no qualification of associated data. This is typical for low level analyses, in that trace levels are often seen in method blanks in the low parts per billion or parts per trillion range and are not an indication of contamination as they are not statistically

significant. Trace levels of target analytes were detected in the MBs for metals at estimated concentrations that were well below their MRLs in the low level metals analyses that were performed for the receiving water program. Receiving water metals concentrations detected during the program were typically 2-3 orders of magnitude higher than those seen in the method blanks. For the 2014 receiving water chemistry program, no QC variances were seen that affected the quality or usability of the data and therefore, no further action was necessary or taken.

5.0 DISCUSSION

5.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

The NPDES permit for the Asplund WPCF requires compliance with applicable State water quality standards as promulgated in Chapter 70 of the Alaska Administrative Code entitled *Water Quality Standards* (18 AAC 70; ADEC, 1999). This chapter requires that criteria outlined in "EPA Quality Criteria for Water" (also known as "The Red Book"; EPA, 1976), the revised quality criteria for water (EPA, 1986b), and other applicable criteria as referenced in the AWQS be met in applicable receiving waters at every point outside of the ZID boundary. Also, as noted in Section 1.1.1, the State of Alaska water quality regulations include site specific criteria for the Point Woronzof area for turbidity and the dissolved fraction of arsenic, cadmium, hexavalent chromium, copper, lead, mercury, nickel, selenium, silver, and zinc. Since the issuance of the current permit, EPA has approved the use of dissolved metals for all of the State's marine water quality criteria, approved all of ADEC's proposed SSWQC for Upper Cook Inlet, and removed Alaska from the National Toxics Rule list (EPA, 2006; Sept. 15, 2006 letter to ADEC). Except for cadmium and mercury, where the chronic cadmium standard changed from 9.3 µg/L in the SSWQC to 8.8 µg/L in the AWQS and the chronic mercury standard which changed from 0.025 µg/L in the SSWQC to 0.94 µg/L in the AWQS, all other dissolved metals criteria are the same in the two standards. Even though EPA has approved the use of dissolved metals criteria for the AWQS, the current SSWQC will most likely remain in effect for the Point Woronzof area for permit renewal as those are also listed in the current AWQS. To be conservative, we have used the more restrictive criteria for dissolved cadmium and mercury to evaluate the data in this report. For other parameters such as TRC we have utilized the current AWQS (ADEC, 2009), since those criteria will be utilized for the permit renewal process. Finally, the permit itself includes some effluent limitations that must be met. The following sections discuss parameters of concern in regards to the requirements of the Permit or the AWQS as well as historical data from the Asplund WPCF, other POTWs, and other EPA data.

5.1.1 Influent and Effluent Monitoring

Table 21 lists permit effluent limitations and marine water quality criteria that are applicable to the current NPDES permit; it includes each required monitoring parameter. Most of the values shown are the chronic toxicity criteria for salt water aquatic life. Chronic toxicity criteria concentrations are lower than acute toxicity criteria concentrations; therefore, the more stringent of the two values were used here for comparison. The MAEC for each parameter was calculated from the outfall design dilution factor of 142:1 (conservative substances) or 180:1 (non-conservative; TRC, ammonia, etc.), the water quality criteria, and the natural background concentrations as determined historically at the control site near Point MacKenzie. Inclusion of natural background levels into this calculation is necessary since it lowers the MAEC as a result of natural concentrations in the receiving water as required by EPA and ADEC modeling procedures. It was assumed that the final effluent would be diluted by a minimum factor of 143 by the time it reached the boundary of the ZID. For most metals, the MAECs were calculated from the SSWQC for dissolved metals contained in the AWQS for the Point Woronzof area.

To determine compliance with State water quality standards, Table 21 values have been compared with effluent values found in Table 8 through Table 11 as well as those in Table 16 and Table 17. AWWU 2014 maximum effluent concentrations shown in Table 21 were the maximum encountered during the calendar year either during AWWU's in-plant monitoring, the

Table 21. NPDES Requirements, State of Alaska Water Quality Standards, and AWWU 2014 Maximum Concentrations for Effluent Comparisons.

Parameter	Receiving Water Quality Standard ^a		Maximum Allowable Effluent Concentration ^b (MAEC)	AWWU 2014 Maximum Effluent Concentration ^c
Antimony (µg/L)	14	Human health, not listed for saltwater aquatic life	2,002	0.677 ^{d, e}
Arsenic (µg/L)	36	Chronic toxicity, measured as dissolved	4,882	3.0 ^{d, e}
Beryllium (µg/L) ^o	5.3	For the protection of aquatic life in soft fresh water	758	0.011 J ^{d, e}
Cadmium (µg/L)	9.3 (8.8) ^g	Chronic toxicity, measured as dissolved	1,322 (1,250)	0.648 J ^f
Chromium (VI) ^h (µg/L)	50	Chronic toxicity, measured as dissolved	7,038	2.02 ^{d, e}
Copper (µg/L)	3.1	Chronic toxicity, measured as dissolved	317	85.5 ^e
Lead (µg/L)	8.1	Chronic toxicity, measured as dissolved	1,140	1.78 ^e
Mercury (µg/L)	0.025 (0.05) ⁱ	Chronic toxicity, measured as dissolved	2.73	0.0546 ^{d, e}
Nickel (µg/L)	8.2	Chronic toxicity, measured as dissolved	978	5.66 ^f
Selenium (µg/L)	71	Chronic toxicity, measured as dissolved	10,136	1.1 ^e
Silver (µg/L)	1.9	Acute toxicity, measured as dissolved	257	0.650 ^e
Thallium (µg/L)	1.7	Human health, not listed for saltwater aquatic life	243	0.006 J ^e
Zinc (µg/L)	81	Chronic toxicity, measured as dissolved	11,249	104 ^e

Table 21. NPDES Requirements, State of Alaska Water Quality Standards, and AWWU 2014 Maximum Concentrations for Effluent Comparisons. (continued)

Parameter	Receiving Water Quality Standard ^a		Maximum Allowable Effluent Concentration ^b (MAEC)	AWWU 2014 Maximum Effluent Concentration ^c
Cyanide (µg/L)	1	For marine aquatic life	181	1.6 J ^{d, e}
Total Aqueous Hydrocarbons (TAQH) (µg/L)	15	Growth and propagation of fish, shellfish, aquatic life, and wildlife including seabirds, waterfowl, and furbearers	2,715	9.82 ^j
Total Aromatic Hydrocarbons as BETX (µg/L)	10	Same as above	1,810	10.4 ^d
pH (pH units)		<i>k</i>	6.5 - 8.5	6.79 – 7.36 ^l
Total Residual Chlorine (TRC) (mg/L)		<i>k</i>	Daily Max. 1.2	Daily Max. 0.94 ^l
BOD ₅ (mg/L)		<i>k</i>	Monthly Avg. 240 Weekly Avg. 250 Daily Max. 300 Monthly Removal Rate ≥30 %	Monthly Avg. 158 ^l Weekly Avg. 183 ^l Daily Max. 213 ^l Monthly Avg. Removal >36% ^l Annual Avg. Removal 42.8% ^l
Total Suspended Solids (TSS) (mg/L)		<i>k</i>	Monthly Avg. 170 Weekly Avg. 180 Daily Max. 190 Monthly Removal Rate ≥30%	Monthly Avg. 65 ^l Weekly Avg. 78 ^l Daily Max. 92 ^l Monthly Avg. Removal >74% ^l Annual Avg. Removal 77.3% ^l
Total Ammonia (mg/L) ^m	8.1 1.2	Acute Chronic	1466 217	Monthly Max. 28.8 ^l
Fecal Coliform (FC MPN/100 mL)		<i>k</i>	Monthly geometric mean of at least five samples shall not exceed 850. Not more than 10% of samples shall exceed 2600.	Monthly mean maximum was 14 ^l The criterion of not more than 10% of samples exceeding 2600 was met in 2014. ^l

Table 21. NPDES Requirements, State of Alaska Water Quality Standards, and AWWU 2014 Maximum Concentrations for Effluent Comparisons. (continued)

Parameter	Receiving Water Quality Standard ^a	Maximum Allowable Effluent Concentration ^b (MAEC)	AWWU 2014 Maximum Effluent Concentration ^c
Other Detected Effluent Constituents with Specific Alaska Water Quality Criteria (µg/L)			
Butyl Benzyl Phthalate	3000 ⁱ	429,000	2.0 J ^d
Chlorobenzene	680 ⁱ	97,240	0.040 J ^d
2-Chlorophenol	120 ⁱ	17,160	0.66 J ^d
1,4- Dichlorobenzene	400 ⁱ	57,200	0.63 ^d
Diethyl phthalate	23,000 ⁱ	3,289,000	4.3 J ^d
Di-n-butyl phthalate	2700 ⁱ	386,100	0.91 J ^d
Ethylbenzene	3100 ⁱ	443,300	0.46 J ^d
Fluoranthene	300 ⁱ	42,900	0.54 J ^d
Phenol	21,000 ⁱ	3,003,000	21 ^d
Pentachlorophenol	7.9 ⁿ	1,130	8.0 J ^d
Toluene	6,800 ⁱ	972,400	7.5 ^d

^a Alaska Administrative Code, 2009. Water Quality Standards, Chapter 70, 18 AAC 70.020(b)

^b For conservative substances, effluent water quality criteria were determined by assuming a dilution of 142:1 at the ZID boundary, where: MAEC = 142 * (Criteria - Natural Background Concentration) + Criteria; pollutant concentrations in the effluent should not exceed these values. For non-conservative substances, a dilution of 180:1 was utilized in the MAEC calculation.

^c For metals, the maximum effluent concentration was determined from both total and dissolved concentrations.

^d Values from June 2014 or August 2014 toxic pollutant and pesticide samplings.

^e Values from AWWU's pretreatment program.

^f Values from effluent tested during receiving water sampling event.

^g Standard based on revised EPA level that was approved for State of Alaska (2001).

^h All samples tested as total chromium.

ⁱ Alaska water quality Human Health criteria for consumption of water & aquatic organisms (ADEC 2008).

^j Maximum value is sum of effluent PAH's and BETX summation tested during receiving water sampling event.

^k MAECs are not based on water quality criteria but instead are specified in MOA's 2000 NPDES permit.

^l Values from AWWU's in-plant monitoring.

^m Ammonia receiving water criteria based on pH of 8.0, temperature of 15.0°C, and salinity of 20 psu.

ⁿ Alaska water quality criteria for aquatic life in marine water (ADEC 2008).

^o Suggested criteria from EPA *Quality Criteria for Water, 1986* (Gold Book). No Alaska Water Quality Standard for Aquatic Life or Human Health.

J Estimated value (below MRL but above MDL).

toxic pollutant and pesticide monitoring events, pretreatment monitoring, or the supplemental effluent monitoring that was performed as part of the receiving water sampling. For metals, both total and dissolved concentrations in the effluent were compared against their MAEC, since it is assumed that all of the metals contained in the effluent are potentially bioavailable upon entering the receiving water. All effluent concentrations were found to be much lower than the MAECs specified in the permit or computed from the AWQS criteria. In addition, the permit limitations for all parameters were met for the 2014 program year. When the MAECs in Table 21 were compared to all of the 2014 data including: AWWU's self-monitoring effluent data, the toxic pollutant and pesticides sampling events (June and August 2014), the pretreatment monitoring data, and the effluent data from the receiving water sampling; metals and cyanide values were all below their MAECs. The highest concentrations of either total or dissolved metals seen in 2014 were all well below their respective MAECs.

The one metal that most closely approached its MAEC at any time was copper, and this was considerably below its MAEC. The maximum concentration of total copper detected in the effluent was 85.5 µg/L compared to a MAEC of 317 µg/L. The highest dissolved copper concentration that was seen in the effluent was 46.1 µg/L. All other effluent dissolved metals concentrations were found to be much less than their respective MAECs.

Of the metals analyzed, beryllium does not have either a SSWQS or an AWQS. While analyzed as both total and dissolved as called for by the permit, beryllium was compared to total recoverable metal MAECs as provided by the EPA criteria for this constituent. As in past years, total recoverable metals detected in the influent and final effluent were compared with data from an EPA study of 40 Publicly Owned Treatment Works (POTWs) in Table 22 (EPA, 1982a). Without exception, metals and cyanide values were lower than or within the range of those detected in other POTWs from across the nation, even though the Asplund WPCF provides only primary treatment as compared to secondary treatment provided at the other plants that were examined in this study.

Historic influent and effluent total recoverable metals and cyanide concentrations collected as part of AWWU's self-monitoring program are presented in Table 23 and Table 24. It should be noted that prior to 2000 when the permit requirements changed, dissolved metals had only been analyzed in a single sample of effluent collected each year during the receiving water sampling. Beginning in 2000, dissolved metals from the effluent have been analyzed in both the summer-wet and summer-dry sampling events and as part of the pretreatment monitoring. Concentrations are very low and fairly consistent over time. Concentrations of total recoverable metals concentrations seen in the influent and effluent during 2014 fell within the range of concentrations seen during prior years. Concentrations of dissolved metals were generally found to fall within the range of concentrations seen over the prior five years as seen in Table 23. In 2014, effluent cyanide concentrations were similar and fell within the range of concentrations seen over the prior five years. Overall, the long-term results for metals and cyanide have always been well within their MAECs and always met AWQS and permit criteria.

Total arsenic concentrations in the final effluent have remained fairly steady over the last five years, and 2014 values remained well within the historic range. The maximum total arsenic concentration in final effluent seen during 2014 was 3.0 µg/L, compared to an MAEC of 4,882 µg/L (Table 21). Arsenic values are not a serious concern for this permit in terms of the effluent, since the concentration in the final effluent has always been so much lower than the MAEC.

Table 22. Comparison Between Influent/Effluent Results for Anchorage and 40 POTWs^a.

Parameter	Anchorage Values				40 POTW Study Values				
	2014 Concentration (µg/L)				Frequency of Detection (%)		Range Detected (µg/L)		Influent Median
	Summer-Dry		Summer-Wet		Influent	Secondary Effluent	Influent	Secondary Effluent	(µg/L)
	INF	EFF	INF	EFF					
VOLATILES ^b									
Benzene	0.22 J	0.26 J	0.20 J	0.20 J	61	23	1-1560	1-72	2
Chloroform	2.5	4.2	2.1	4.2	91	82	1-430	1-87	7
1,4-Dichlorobenzene	0.69	0.63	0.68	0.58	17	3	2-200	3-9	NA
Ethylbenzene	4.7	0.46 J	0.22 J	0.23 J	80	24	1-730	1-49	8
Methylene chloride	1.2 J	1.7 J	1.4 J	3.0	92	86	1-49000	1-62000	38
Tetrachloroethene	0.41 J	0.40 J	0.16 J	0.13 J	95	79	1-5700	1-1200	23
Toluene	20	7.5	3.8	5.4	96	53	1-13000	1-1100	27
SEMI-VOLATILES ^b									
Bis(2-ethylhexyl)phthalate	8.0 J	8.8 J	16	12	92	84	2-670	1-370	27
Butyl benzyl phthalate	2.8 J	2.0 J	3.0 J	1.4 J	57	11	2-560	1-34	3
Diethyl phthalate	2.9 J	3.0 J	4.0 J	4.3 J	53	13	1-42	1-7	3
Di-N-butyl phthalate	0.51 J	0.91 J	0.73 J	0.76 J	64	52	1-140	1-97	4
Phenol	24	21	120	19	79	29	1-1400	1-89	7
2,4,6-Trichlorophenol	ND	0.61 J	ND	0.74 J	5	3	1-11	1-3	NA
TOTAL METALS & OTHER COMPONENTS									
Antimony	0.801	0.675/0.677	0.429	0.447	14	13	1-192	1-69	NA
Arsenic	3.3	2.9 / 3.0	2.2	2.3	15	12	2-80	1-72	NA
Beryllium	0.016 J	0.011J/0.008J	0.007 J	ND	3	1	1-4	1-12	NA
Cadmium	0.290	0.187 / 0.186	0.197	0.167	56	28	1-1800	2-82	3
Chromium	3.09	2.02 / 1.97	1.93	1.09	95	85	8-2380	2-759	105
Copper	73.2	39.2 / 39.5	46.0	31.6	100	91	7-2300	3-255	132
Lead	3.15	1.59 / 1.59	1.94	1.53	62	21	16-2540	20-217	53
Mercury	0.134	0.0546	0.0496	0.0328	70	31	0.2-4	0.2-1.2	0.517
Molybdenum	3.63	5.34 / 5.13	1.68	1.74	NA	NA	NA	NA	NA
Nickel	7.10	5.40 / 5.52	3.74	3.04	79	75	5-5970	7-679	54
Selenium	0.6 J	0.8 J / 0.8 J	0.8 J	0.8 J	9	10	1-10	1-150	NA
Silver	0.604	0.296 / 0.278	0.189	0.128	71	25	2-320	1-30	8
Thallium	ND	ND / ND	0.008 J	0.005 J	3	2	1-19	1-2	NA
Zinc	181	94.7 / 96.4	122	61.1	100	94	22-9250	18-3150	273
Cyanide	0.9 J	1.6 J	ND	ND	100	97	3-7580	2-2140	249

^a Source: EPA, 1982a. *Fate of Priority Pollutants in POTWs*. Final Report, Volume I, EPA 440/1-82/303

^b Only analytes detected in either the influent or effluent and in the 40 POTW study are included.

J Estimated value

NA Not available

ND Not detected

Table 23. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years.

Pollutant	2009		2010		2011	
	Drv	Wet	Drv	Wet	Drv	Wet
	6/23-24	7/28-29	7/13-14	8/17-18	6/14-15	7/31-8/1
ORGANICS (µg/L)						
Acetone	ND	100	130 B	180	140	110
Acenaphthylene	ND	ND	ND	ND	ND	ND
Benzene	0.240 J	ND	ND	ND	0.10 J	0.14 J
Benzo(a)anthracene	ND	ND	ND	ND	0.38 J	ND
Benzoic acid	241	141	ND	ND	ND	ND
Benzyl alcohol	28.4	25.8	ND	ND	ND	ND
Bis-(2-ethylhexyl) phthalate	ND	ND	14	ND	15	14
Bromodichloromethane	ND	ND	ND	ND	0.29 J	0.27 J
2-Butanone (MEK)	ND	ND	ND	ND	20	9.9 J
Butyl benzyl phthalate	ND	ND	ND	ND	3.1 J	2.6 J
Carbon disulfide	ND	ND	ND	ND	0.38 J	0.48 J
Chlorobenzene	ND	ND	ND	ND	0.040 J	0.040 J
Chloroethane	ND	ND	ND	ND	ND	ND
Chloroform	3.24	2.0 J	3.5 J	3.0 J	3.6	3.5
Chloromethane	ND	ND	95 J	ND	0.51	0.69
2-Chlorophenol	ND	ND	ND	ND	0.85 J	0.54 J
*1,4-Dichlorobenzene	0.790 J	0.68 J	0.73 J	0.67 J	0.73	0.87
cis 1,2-Dichloroethene	ND	ND	ND	ND	0.070 J	0.060 J
2,4-Dichlorophenol	ND	ND	ND	ND	0.66 J	0.33 J
Diethyl phthalate	ND	ND	ND	ND	7.9 J	7.3 J
Di-N-butyl Phthalate	ND	ND	ND	ND	2.3 J	1.5 J
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND
Di-N-octyl Phthalate	ND	ND	ND	ND	0.54 J	ND
1,2-Diphenylhydrazine	ND	ND	ND	ND	3.6 J,X	ND
Ethylbenzene	1.18	ND	ND	ND	0.47 J	0.46 J
Fluoranthene	ND	ND	ND	ND	0.56 J	ND
3&4 Methylphenol	11.0	4.2 J	6.0 B	7.2 B	1.7 J	1.1 J
Naphthalene	ND	ND	99	84.0	120	72
2-Nitrophenol	ND	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	119	78.1	ND	ND	ND	ND
N-Nitrosodi-n-propylamine	ND	ND	ND	ND	ND	ND
Methylene Chloride	ND	ND	ND	ND	6.5 J,X	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND
Phenol	18.1	ND	ND	ND	28	22
Styrene	ND	ND	ND	ND	0.34 J	0.14 J
Tetrachloroethene	1.14	ND	ND	ND	0.47 J	0.21 J
Trichloroethene	ND	ND	ND	ND	0.070 J	0.060 J
2,4,6-Trichlorophenol	ND	ND	ND	ND	1.5 J	1.0 J
Toluene	8.84	5.5	9.8	6.3	8.1	8.8
* Total Xylenes	3.68	1.7 J	4.7 J	5.7 J	1.57 J	1.47 J
Total Hydrocarbons as O&G	37600	64900	35500	49100	28500	26200
TAH as BETX	13.9	17.2	18.5	16.0	10.18	10.87
OTHER						
Cyanide (µg/L)	ND	16	ND	5.0	4 J	8 J
Asbestos (million fibers/L)	ND	ND	14.8	ND	ND	ND

Table 23. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. (continued)

Pollutant	2012		2013		2014	
	Dry ^a	Wet	Dry	Wet	Dry	Wet
	6/19-20	8/6-7	6/10-11	8/26-27	6/11-12	8/3-4
ORGANICS (µg/L)						
Acetone	180	150 D	140	140	230	140
Acenaphthylene	0.36 J	0.95 J	ND	ND	ND	ND
Benzene	0.25 J	0.36 J,D	0.16 J	0.22 J	0.26 J	0.20 J
Benzo(a)anthracene	ND	ND	0.30 J	ND	ND	ND
Benzoic acid	ND	ND	ND	ND	ND	ND
Benzyl alcohol	ND	ND	ND	ND	ND	ND
Bis-(2-ethylhexyl) phthalate	15	14	17 B	16	8.8 J	12
Bromodichloromethane	0.45 J	0.16 J,D	0.21 J	0.17 J	0.20 J	0.20 J
2-Butanone (MEK)	33	17 J,D	15 J	27	51	16 J
Butyl benzyl phthalate	2.4 J	3.0 J	4.5 J	2.3 J	2.0 J	1.4 J
Carbon disulfide	0.35 J	0.42 J,D	0.31 J	0.38 J	0.41 J	0.52
Chlorobenzene	ND	ND	ND	0.040 J	0.040 J	ND
Chloroethane	ND	ND	0.16 J	ND	0.41 J	ND
Chloroform	4.7	3.8 D	3.7	3.3	4.2	4.2
Chloromethane	0.76	0.88 J,D	0.50	0.73	0.80	1.2
2-Chlorophenol	ND	ND	0.77 J	ND	ND	0.66 J
* 1,4-Dichlorobenzene	0.84	0.68 J,D	0.59	0.63	0.63	0.58
cis-1,2-Dichloroethene	ND	ND	0.080 J	0.080 J	0.14 J	ND
2,4-Dichlorophenol	ND	0.80 J	0.51 J	ND	ND	ND
Diethyl phthalate	5.7 J	4.7 J	4.4 J	2.1 J	3.0 J	4.3 J
Di-N-butyl phthalate	0.87 J	0.99 J	0.88 J	0.86 J	0.91 J	0.76 J
2,4-Dinitrophenol	ND	ND	16 J	ND	ND	ND
Di-N-octyl phthalate	ND	ND	ND	0.47 J	ND	7.6 J
1,2-Diphenylhydrazine	0.52 J	ND	ND	ND	ND	ND
Ethylbenzene	1.1	0.66 J,D	0.37 J	0.43 J	0.46 J	0.23 J
Fluoranthene	0.58 J	ND	0.52 J	ND	0.54 J	ND
Methylene chloride	3.2	2.6 J,D	0.57 J	0.86 J	1.7 J	3.0
3&4 Methylphenol	110	NT	ND	ND	ND	ND
Naphthalene	0.58 J	0.57 J	ND	ND	0.57 J	ND
2-Nitrophenol	ND	ND	ND	ND	1.6 J	ND
N-Nitrosodimethylamine	ND	ND	ND	ND	ND	ND
N-Nitrosodi-n-propylamine	ND	ND	ND	ND	6.1 J	ND
Pentachlorophenol	ND	ND	ND	ND	ND	8.0 J
Phenanthrene	0.75 J	0.58 J	ND	ND	0.47 J	ND
Phenol	23	25	28	22	21	19
Styrene	ND	1.4 D	0.030 J	0.050 J	0.050 J	0.070 J
Tetrachloroethene	0.91	0.48 J,D	0.40 J	0.47 J	0.40 J	0.13 J
Trichloroethene	ND	ND	0.050 J	0.060 J	0.070 J	ND
2,4,6-Trichlorophenol	ND	1.1 J	0.93 J	ND	0.61 J	0.74 J
Toluene	8.7	9.3 D	4.9	8.8	7.5	5.4
* Total Xylenes	6.9	3.2 D	1.46 J	2.07	2.23	0.88 J
Total Hydrocarbons as O&G	14700	37100	7600	9100	10200	13900
TAH as BETX	17.0	13.5	6.9	11.5	10.4	6.7
OTHER						
Cyanide (µg/L)	6 J / 5 J	ND	10	7 J	1.6 J	ND
Asbestos (million fibers/L)	ND	ND	ND	ND	ND	ND

Table 23. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. (continued)

Pollutant	2009		2010		2011	
	Dry	Wet	Dry	Wet	Dry	Wet ^a
	6/23-24	7/28-29	7/13-14	8/17-18	6/14-15	7/31-8/1
TOTAL METALS (µg/L)						
Antimony	ND	ND	ND	ND	0.50	0.66 / 0.44
Arsenic	ND	ND	ND	ND	2.72	2.79 / 2.56
Beryllium	ND	ND	ND	ND	ND	0.017 J / ND
Cadmium	ND	ND	0.660	ND	0.253	0.296 / 0.214
Chromium	ND	ND	ND	ND	1.68	1.22 / 1.14
Copper	48.9	34.9	82.9	41.9	35.4	30.5 / 30.3
Lead	2.35	1.8	2.38	1.81	2.470	1.400 / 1.230
Mercury	ND	ND	ND	ND	0.06 J	0.07 J
Molybdenum	ND	ND	ND	ND	3.38	1.91 / 1.68
Nickel	3.62	2.98	3.62	3.96	4.53	3.02 / 2.90
Selenium	ND	ND	ND	ND	1.5 J	2.0 J / 1.7 J
Silver	1.56	ND	ND	ND	0.711	0.298 / 0.197
Thallium	ND	ND	ND	ND	ND	0.206 / 0.017 J
Zinc	97.4	81.4	118	94.9	80.2	65.4 / 64.6
DISSOLVED METALS (µg/L)						
Antimony	ND	ND	ND	ND	0.60	0.65
Arsenic	ND	ND	ND	ND	2.29	2.19
Beryllium	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	0.119	0.086
Chromium	ND	ND	ND	ND	0.73	0.64
Copper	14.0	26.8	48.0	13.3	21.8	17.3
Lead	ND	0.917	0.964	0.356	0.430	0.340
Mercury	ND	ND	0.302	ND	ND	ND
Molybdenum	ND	ND	ND	ND	3.05	1.78
Nickel	2.94	2.77	3.73	3.85	3.98	2.59
Selenium	ND	ND	ND	ND	1.6	1.4
Silver	ND	ND	ND	ND	0.106	0.054
Thallium	ND	ND	ND	ND	ND	0.009 J
Zinc	38.4	58.4	75.3	28.0	40.1	33.4
PESTICIDES (µg/L)						
Aldrin	ND	ND	ND	ND	ND	ND
alpha-BHC	ND	ND	ND	ND	ND	ND
beta-BHC	ND	0.014 P	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND
Endosulfan sulfate	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND
Endrin ketone	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND
2,4'-DDD	ND	ND	0.012	ND	ND	ND
4,4'-DDE	ND	0.010	ND	ND	ND	ND
4,4'-DDT	0.25 P	ND	0.086 P	0.094 P,D	ND	ND

Table 23. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. (continued)

Pollutant	2012		2013		2014	
	Dry ^a	Wet	Dry	Wet	Dry ^a	Wet
	6/19-20	8/6-7	6/10-11	8/26-27	6/11-12	8/3-4
TOTAL METALS (µg/L)						
Antimony	0.451	0.463	0.53	0.51	0.675 / 0.677	0.447
Arsenic	2.37	2.2	2.25	2.46	2.9 / 3.0	2.3
Beryllium	0.009 J	ND	ND	ND	0.011 J / 0.008 J	ND
Cadmium	0.142	0.258	0.226	0.209	0.187 / 0.186	0.167
Chromium	1.44	1.18	2.08	1.15	2.02 / 1.97	1.09
Copper	30.3	30.4	41.8	38.2	39.2 / 39.5	31.6
Lead	1.660	1.780	1.74	2.270	1.59 / 1.59	1.53
Mercury	0.04J/0.04J	0.08 J	0.07 J	0.02 J	0.0546	0.0328
Molybdenum	3.08	4.150	11.8	2.30	5.34 / 5.13	1.74
Nickel	3.81	3.38	4.22	3.88	5.40 / 5.52	3.04
Selenium	1.0 J	1.3	1.0 J	0.8 J	0.8 J / 0.8 J	0.8 J
Silver	0.518	0.386	1.570	0.423	0.296 / 0.278	0.128
Thallium	0.0037 J	ND	ND	ND	ND / ND	0.005 J
Zinc	81.7	80.7	98.9	81.3	94.7 / 96.4	61.1
DISSOLVED METALS (µg/L)						
Antimony	0.540	0.423	0.55	0.58	0.571	0.374
Arsenic	1.95	1.8	2.05	2.14	2.5	2.2
Beryllium	ND	ND	ND	ND	ND	ND
Cadmium	0.070	0.088	0.131	0.091	0.083	0.085
Chromium	0.76	0.43	1.59	0.63	0.91	0.76
Copper	15.4	12.1	25.8	21.8	23.2	19.3
Lead	0.328	0.323	0.366	0.431	0.558	0.496
Mercury	ND	0.04 J	ND	ND	0.00611	0.00661
Molybdenum	2.79	3.770	12.2	2.18	4.81	1.68
Nickel	3.47	2.81	3.91	3.40	4.56	2.68
Selenium	0.9 J	0.9 J	1.2	1.0 J	0.6 J	1.0 J
Silver	0.062	0.071	0.213	0.077	0.082	0.041
Thallium	0.0014 J	ND	ND	ND	ND	ND
Zinc	41.8	36.1	51.1	44.2	54.2	34.8
PESTICIDES (µg/L)						
Aldrin	ND	ND	ND	0.0018 J,P	ND	ND
alpha-BHC	ND	ND	ND	ND	ND	ND
beta-BHC	ND	ND	ND	ND	ND	ND
Dieldrin	0.0062 J	ND	0.020	ND	ND	ND
Endosulfan sulfate	0.00099J,P	ND	ND	ND	ND	ND
Endrin	ND i	ND	ND	ND	ND	ND
Endrin ketone	ND	ND	ND	0.0023 J,P	ND	ND
Heptachlor	ND	ND	0.015	ND	ND	ND
2,4'-DDD	ND	ND	ND	ND	ND	ND
4,4'-DDE	ND i	ND	ND	ND	ND	ND
4,4'-DDT	ND	ND	ND	ND	ND	ND

^a Duplicate effluent collected (field duplicate) or analyzed (lab duplicate) shown as value/duplicate value

i Matrix interference results in elevated MRL/MDL. * Non-priority pollutant J Estimated value D Sample diluted for analysis.

X Matrix interference results in slight high bias.

P More than 40% RPD between primary and confirmation results. The higher of the two results is reported.

B Compound also detected in method blank

ND Not detected

Table 24. Historical Discharge Monitoring Data (1986 - Present) for Influent and Effluent Total Metals and Cyanide Concentrations in µg/L.

Year	Average Flow (MGD)	Arsenic		Beryllium		Cadmium		Copper		Lead		Mercury		Nickel		Silver		Zinc		Chromium		Cyanide	
		INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF
1986-2008 Min	23	<1	<1	<0.03	<0.03	<0.3	0.2	30	10	<1	<1	<0.1	0.04	<1	<1	1	1	54	38	<1	<1	<0.4	<0.9
1986-2008 Max	40	26	16	0.6	0.3	20	30	280	150	149	50	3.0	1.5	77	60	30.4	98	299	407	112	120	85	59
2009 Avg	28	<5	<5	<0.4	<0.4	<0.5	<0.5	55	59	4	4	<0.2	<0.2	4	4	1.3	1.5	124	119	2	2	<5	11
2009 Min	26	<5	<5	<0.4	<0.4	<0.5	<0.5	33	35	2	2	<0.2	<0.2	3	3	<1	<1	63	81	<2	<2	<5	<5
2009 Max	31	<5	<5	<0.4	<0.4	<0.5	<0.5	74	128	9	8	<0.2	<0.2	5	6	1.8	3.2	165	220	3	3	<5	21
2010 Avg	27	<5	<5	<0.4	<0.4	1.16	0.53	67.5	54.8	4.7	2.3	<0.2	<0.2	6.1	4.2	1.4	<1	406	109	3.9	<2	<5.0	5.8
2010 Min	24	<5	<5	<0.4	<0.4	<0.5	<0.5	58.0	41.9	3.19	1.81	<0.2	<0.2	5.1	3.6	<1	<1	159	95	3.0	<2	<5.0	<5.0
2010 Max	30	<5	<5	<0.4	<0.4	3.67	0.660	83.6	82.9	8.02	3.79	<0.2	<0.2	7.2	4.5	2.19	<1	1520	118	4.9	<2	<5.0	7.7
2011 Avg	25	2.7	2.6	0.02	0.01	0.35	0.24	64.4	34.1	3.70	1.88	0.36	0.10	6.3	3.8	1.2	0.7	170	79	3.2	1.6	<3	4
2011 Min	23	2.2	2.5	0.010	<0.006	0.23	0.18	51.0	30.5	1.94	1.40	0.15	0.06	4.1	3.0	0.3	0.3	122	65	2.0	1.2	<3	<3
2011 Max	27	3.5	2.8	0.034	0.017	0.44	0.30	80.6	36.3	4.65	2.47	0.77	0.15	10.2	4.5	2.5	1.1	203	88	4.0	1.7	<3	8
2012 Avg	27.7	2.6	2.3	0.018	0.008	0.33	0.23	57.9	30.5	4.2	1.9	0.17	0.06	5.4	3.8	1.2	0.6	174	83	2.9	1.5	3	4
2012 Min	23.9	2.3	2.2	0.006	0.006	0.25	0.14	49.8	29.8	2.8	1.5	0.06	0.04	4.7	3.4	0.6	0.4	157	77	2.1	1.2	<3	<3
2012 Max	33.7	2.9	2.4	0.030	0.010	0.46	0.38	71.1	31.2	7.5	2.4	0.57	0.08	7.5	4.3	2.6	0.9	216	90	4.4	1.8	5 J	6 J
2013 Avg	27.9	2.8	2.4	0.010	0.006	0.276	0.197	57.0	39.4	3.2	1.8	0.11	0.05	5.7	4.3	0.53	0.79	151	92	2.9	1.7	6	6
2013 Min	24.8	2.4	2.2	0.006	<0.003	0.265	0.167	51.0	33.0	2.5	1.4	0.05	0.02	5.0	3.9	0.01	0.40	135	75	2.2	1.2	<3	<3
2013 Max	32.8	4.0	2.6	0.023	0.008	0.303	0.231	62.0	48.0	4.0	2.3	0.22	0.07	6.6	4.6	1.38	1.57	168	118	3.4	2.1	7	10
2014 Avg	26.8	2.8	2.7	0.014	0.007	0.284	0.185	63.3	41.8	2.8	1.6	0.14	0.03	6.4	4.8	0.46	0.31	182	86	2.7	1.6	0.9	1.2
2014 Min	23.9	2.2	2.3	0.007	<0.006	0.197	0.167	46.0	30.5	1.9	1.3	0.05	0.02	3.7	3.0	<0.004	0.128	122	61	1.9	1.1	<0.9	<0.9
2014 Max	29.0	3.3	3.0	0.021	0.011	0.362	0.201	92.2	85.5	3.9	1.8	0.30	0.05	8.6	5.5	1.18	0.650	215	104	3.2	2.0	1.0	1.6

Avg Mean
 EFF Effluent
 INF Influent
 Min Minimum
 Max Maximum
 < Less than Method Detection Limit

During 2014, cyanide concentrations in the effluent ranged from < 0.9 to $1.6 \text{ J } \mu\text{g/L}$, well below the MAEC of $181 \mu\text{g/L}$. Cyanide had been a constituent of concern in the prior permit because it approached or even exceeded the prior MAEC of $50 \mu\text{g/L}$ in some years. In 1986 it was observed that the effluent cyanide concentrations often exceeded the influent concentrations by an order of magnitude. This trend continued during subsequent years of sampling and was the subject of a special investigation that concluded that the measured increase in cyanide between the influent and effluent was the result of the treatment plant's incinerator. Cyanide formed in the incinerator during sludge incineration was returned to the plant during the stack scrubbing process. Subsequently, cyanide decreased and this was believed to be due to the change in the scrubber water source from recirculated primary effluent to well water.

The most restrictive criteria of growth and propagation of fish, shellfish, other aquatic life, and wildlife was used for the hydrocarbon limits presented in Table 21. The MAECs for TAqH and TAH as BETX were met again this year, the levels detected in the effluent were all found to be substantially below their MAECs. The parameter of TAqH was analyzed in effluent only during the receiving water quality sampling, and the TAqH concentration was $9.82 \mu\text{g/L}$ as compared to the MAEC of $2,715 \mu\text{g/L}$. The maximum BETX (TAH) value of $10.4 \mu\text{g/L}$ (measured by EPA method 624) was seen during the June 2014 toxic pollutant and pesticide sampling, and this value fell well below the MAEC of $1,810 \mu\text{g/L}$.

The MAEC for total ammonia was met again this year, with effluent values exhibiting a maximum of 28.8 mg/L as compared to the MAEC of 217 mg/L for the chronic limit and a MAEC of $1,466 \text{ mg/L}$ for the acute limit. These MAECs are based on saltwater acute ammonia criteria of 8.1 mg/L and saltwater chronic criteria of 1.2 mg/L , which are a function of temperature, salinity, and pH as presented in the AWQS. For comparison in this report, ammonia criteria were based on a salinity of 20 psu, temperature of 15°C , and a pH of 8.0 units.

For fecal coliform, the permit limitation of a monthly geometric mean (of at least five samples) that shall not exceed 850 FC/100 mL was met for all months in 2014, with the maximum monthly geometric mean of 14 FC/100 mL. Fecal coliform met the monthly criteria "that not more than 10% of the effluent samples shall exceed 2600 FC/100 mL during any month" for all months in 2014.

In addition to the MAECs that are based on the AWQS criteria, a number of other effluent limitations are specified in the NPDES permit. These daily, weekly, and monthly limitations for effluent concentrations and loading include: pH, TRC, BOD₅, TSS, and fecal coliform (Table 21). All results for these parameters met permit limitations for 2014.

The permit limitations for monthly and weekly averages and daily maximum were met for BOD₅ and TSS. Amendments to the CWA, require at least 30% average monthly removal for both of these parameters. BOD₅ and TSS met this requirement on both an average monthly and annual basis with the lowest monthly removal of 36.5% for BOD₅ and 74.3% for TSS. Removal of BOD₅ averaged 42.8% for the 2014 calendar year which is similar to that seen during the previous five years where average annual removals ranged from 45 to 48%. The monthly removal for TSS ranged from 74.3 to 81.0% with an annual average of 77.3%, about the same as reported for the last eleven years and well above the required average monthly criteria of 30%.

Concentrations of other toxic pollutants and pesticides detected in the influent and final effluent were generally lower than or within the range of those detected in other POTWs from across the

nation, even though the Asplund WPCF provides only primary treatment as compared to secondary treatment provided at the other plants (Table 22). Toxic pollutants and pesticides also generally fell within the historical range of values seen in past years; levels of toxic pollutants and pesticides detected in the Anchorage effluent this year and over the previous five years are shown in Table 23. These data indicated some variability over time, but a generally similar pattern overall. Levels were low and often below reporting limits. As in the past, the types and concentrations of measured organic compounds varied between the two sampling periods. Also, in some instances, differences in pollutant concentrations occurred between the influent and effluent. Inconsistencies can be explained by looking at sampling methodology and plant operation in the case of point-source contaminants. If spikes of contaminants are occurring in the influent, these might be hit or missed during influent sampling. On the other hand, an effluent sample could contain the contaminant because of mixing in the clarifiers. Differences in concentrations in influent and effluent samples could also be due to lower TSS in the effluent samples and the residence time at the facility. This can be seen in Table 9 and Table 10, where greater variability usually occurs in the influent concentrations as compared to the effluent. Also, the effluent includes contributions from both the Eagle River and Girdwood WWTFs since sludge from those facilities is processed at the Asplund WPCF.

Historic discharge monitoring data (1986 - 2014) for other parameters of concern measured in the influent and effluent are presented in Table 25. Most parameters have remained fairly steady over time. Dissolved oxygen levels increased from 1986 with a peak in 1992, and then generally decreased over the next ten years. Levels of DO over the past six years including 2014 have been fairly consistent and within the range of 1.2 to 4.3 mg/L.

Other constituents of potential concern such as TSS have remained fairly steady in both the influent and effluent over the past six years and within the range of that seen historically with an effluent range of 47 to 82 mg/L over the past six years. The BOD₅ effluent average during 2014 (158 mg/L) is slightly higher than that seen in recent years, but well within the range seen historically and within the range of 83 to 173 mg/L seen over the past six years.

The yearly average effluent fecal coliform bacteria concentration, reported at 5 FC/100 mL for 2014, was lower than that seen in 2009 through 2013. Elevated levels seen in 2004 were the highest yearly average seen on the program to date and were most likely the result of a program to optimize chlorine usage as described below. Lower fecal coliform values for 2009 through 2014 showing a downward trend are more in line with prior data, indicating that the disinfection efficacy at the WPCF has been improving.

As described in earlier reports, a project to improve the efficiency of the Asplund WPCF effluent disinfection system was implemented during 2001-2002. The chlorine injection process was improved by installation of rapid mixing equipment (the “Water Champ”, installed in November 2001) to mix chlorine gas directly with the effluent. Oxidation Reduction Potential (ORP) technology using a *Stranrol 890 Controller* was installed in December 2001 to control the chlorine dosage rate by adjusting it in response to both flow and oxidation reduction potential of the wastewater. Prior to this improvement, it was never possible to determine an exact correlation between TRC and coliform kill. Dosage control by the ORP has resulted in adequate coliform kills with far lower chlorine residuals and has substantially reduced the annual chlorine

Table 25. Historical Mean Monthly Discharge Monitoring Data (1986 - Present) for Influent and Effluent Non-Metals.

Year	Temperature (°C)		pH ^a (pH units)		TRC (mg/L)		DO (mg/L)		BOD ₅ (mg/L)		TSS (mg/L)		Fecal Coliform (MPN/100 mL)		Ammonia (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
1986-2008 Min	9.0	9.0	6.4	6.4	NT	0.07	NT	1.5	98	69	117	37	NT	3	NT	13.8
1986-2008 Max	17.0	18.0	8.5	8.5	NT	1.00	NT	8.6	296	174	307	86	NT	1213	NT	29.3
2009 Avg	11.7	12.2	NA	NA	NT	0.34	NT	2.8	235	125	239	56	NT	14	NT	21.6
2009 Min	8.9	9.4	6.6	6.5	NT	0.24	NT	1.3	172	83	187	48	NT	5	NT	18.2
2009 Max	14.7	15.4	7.9	7.4	NT	0.52	NT	4.3	274	145	269	63	NT	30	NT	25.8
2010 Avg	12.8	13.0	NA	NA	NT	0.29	NT	3.0	253	133	252	53	NT	18	NT	22.9
2010 Min	10.2	10.6	6.6	6.5	NT	0.22	NT	2.3	216	109	218	47	NT	7	NT	14.6
2010 Max	15.2	15.4	8.0	7.7	NT	0.43	NT	3.6	280	159	289	61	NT	49	NT	26.7
2011 Avg	12.7	12.9	NA	NA	NT	0.33	NT	2.4	271	146	271	60	NT	10	NT	25.5
2011 Min	9.9	10.3	7.1	6.8	NT	0.29	NT	1.6	246	129	244	53	NT	2	NT	19.9
2011 Max	15.7	16.0	8.0	7.7	NT	0.37	NT	3.3	314	166	315	71	NT	22	NT	40.2
2012 Avg	12.3	12.2	NA	NA	NT	0.38	NT	2.6	257	141	255	63	NT	7	NT	23.8
2012 Min	9.9	10.3	6.8	6.7	NT	0.30	NT	2.0	217	119	226	54	NT	3	NT	18.2
2012 Max	14.6	14.8	7.8	7.7	NT	0.45	NT	3.5	300	165	309	82	NT	>17	NT	27.7
2013 Avg	12.7	12.4	NA	NA	NT	0.45	NT	2.4	260	141	255	63	NT	6	NT	23.3
2013 Min	10.1	9.9	6.9	6.9	NT	0.39	NT	1.7	218	118	230	56	NT	2	NT	15.9
2013 Max	15.7	16.0	7.9	7.7	NT	0.53	NT	3.3	324	163	321	67	NT	26	NT	26.7
2014 Avg	13.4	12.9	NA	NA	NT	0.46	NT	2.3	276	158	260	59	NT	5	NT	23.9
2014 Min	11.1	10.3	7.00	6.79	NT	0.36	NT	1.2	254	135	225	53	NT	2	NT	21.2
2014 Max	15.5	15.9	7.78	7.36	NT	0.59	NT	3.6	309	173	305	65	NT	14	NT	28.8

^a Values represent monthly pH minimum and maximum.

Avg Mean

Min Minimum

Max Maximum

NA Not applicable

NT Not tested

usage, but optimizing the disinfection process continues to be an on-going focus. Also, with the trending tools being developed in the new Hach Water Information Management System, it is believed that additional optimization of the disinfection processes may be possible.

The average TRC had dropped from 0.8 mg/L in 2001 to 0.4 mg/L in 2002, and then leveled out at approximately 0.35 mg/L. The average TRC in 2014 of 0.46 mg/L was slightly higher than the yearly average range of 0.29 to 0.45 mg/L seen during the prior five years. The fecal coliform monthly average rose from 39 FC/100 mL in 2001 to a high of 325 FC/100 mL in 2004, and has since then steadily fallen. The 2014 monthly average for fecal coliforms was 5 FC/100 mL.

Quarterly WET testing was conducted on 24-hr flow composite effluent samples during all four quarters of calendar year 2014. The annual three-species screening test was performed in the first quarter of 2014 and determined the sea urchin to again be the most sensitive species tested. Only echinoderm fertilization tests were performed during the second, third, and fourth quarters of 2014. Discernable toxicity was observed in echinoderm fertilization tests at the highest concentration of effluent tested during the first and third quarters (2.8%). All results were found to be acceptable and well below the permit specified TUC level ($TUC \leq 143$) that would trigger additional testing.

In summary, effluent chemistry monitoring indicated that with no exceptions, effluent concentrations of toxic pollutants and pesticides, metals and cyanide, and conventional parameters were much lower than their applicable permit limits and their MAECs. All toxic pollutants and pesticides concentrations including metals and cyanide were lower than or within the range of those detected at secondary treatment plants from across the nation. WET testing indicated that the final effluent was within the WET acceptance range for all of 2014.

5.1.2 Sludge Monitoring

The current permit requires sludge monitoring twice per year, once each during the dry and wet conditions in summer as part of the toxic pollutant/pretreatment monitoring. There are no Part 503 monitoring requirements included in the permit, but sludge monitoring is required because the Part 503 regulations are self-implementing as described in Section 2.1.5. Part 503 monitoring of sludge at Asplund WPCF has been included in this report (Table 13) and will also be reported separately to EPA as required by the regulations by 19 February 2014.

While the current permit does not contain sludge limits for levels of toxic pollutants and pesticides, comparisons can be made for these data based on other treatment facilities' monitoring results and to the site specific allowable limits for metals that were determined for the facility (Table 26). In all cases, sludge metals were found to be substantially lower than the site specific allowable limits (Table 13). Again, data indicate that average concentrations of toxic pollutants and pesticides in Anchorage's sludge are generally lower than "typical" concentrations seen at other treatment facilities (Table 26) (EPA, 1985c). In the 2014 Part 503B metals sampling, arsenic ranged from 2.7 to 5.8 mg/kg with an average of 4.6 mg/kg compared to a typical value of 4.6 mg/kg and a 95th percentile value of 20.77 mg/kg seen at other facilities across the nation.

Table 26. Comparison Between Sludge Results for Anchorage and Typical and Worse Case Concentrations Used by EPA in Developing Median or Mean Environmental Profiles^a.

Pollutant (mg/kg)	2014 Anchorage Values			Typical Concentration	95 th Percentile "Worse Case"
	June ^b	August ^b	2014 AVG ^c		
Aldrin/Dieldrin	ND	ND	---	0.07	0.81
Arsenic	5.26 / 4.82	5.39	4.6	4.6	20.77
Benzene	0.0028 J	0.0041 J	---	0.326	6.58
Benz(a)anthracene	0.53 J	ND	---	0.68	4.8
Benzo(a)pyrene	0.44 J	ND	---	0.14	1.94
Beryllium	0.067 / 0.062	0.080	0.06	0.313	1.168
Bis(2-ethylhexyl)phthalate	21	14	---	94.28	459.25
Cadmium	1.12 / 1.17	1.44	1.24	8.15	88.13
Carbon Tetrachloride	ND	ND	---	0.048	8.006
Chlordane (α,γ)	ND	ND	---	3.2	12
Chloroform	0.0011 J	0.0025 J	---	0.049	1.177
Chromium	15.2 / 14.0	16.6	14.4	230.1	1499.7
Copper	236 / 227	230	---	409.6	1427
Cyanide	0.21 J	0.35 J	---	476.2	2686.6
DDT/DDE/DDD	ND	ND	---	0.28	0.93
3,3-Dichlorobenzidine	ND	ND	---	1.64	2.29
Methylene chloride	0.012 J	0.011 J	---	1.6	19
Endrin	ND	ND	---	0.14	0.17
Heptachlor (epoxide)	ND	ND	---	0.07	0.09
Hexachlorobenzene	ND	ND	---	0.38	2.18
Hexachlorobutadiene	ND	ND	---	0.3	8
Lead	14.1 / 14.7	20.3	14.9	248.2	1070.8
alpha/gamma-BHC (Lindane)	ND	ND	----	0.11	0.22
Malathion	ND	ND	---	0.045	0.63
Mercury	0.590	0.560	0.52	1.49	5.84
Nickel	14.3 / 12.6	14.1	12.2	44.7	662.7
PCBs	ND	ND	---	0.99	2.9
Pentachlorophenol	ND	ND	---	0.0865	30.434
Phenanthrene	2.2 J	1.4 J	---	3.71	20.69
Phenol	ND	1.1 J	---	4.884	82.06
Selenium	2.27 / 2.15	2.05	---	1.11	4.848
Tetrachloroethene	0.019	0.025	---	0.181	13.707
Trichloroethene	ND	ND	---	0.46	17.85
2,4,6-Trichlorophenol	ND	ND	---	2.3	4.6
Vinyl Chloride	ND	ND	---	0.43	311.942
Zinc	661 / 631	751	---	677.6	4580

^a Source: EPA 1985c. *Summary of Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge: Methods and Results*. Office of Water Regulations and Standards, Appendix F.

^b Data from NPDES 2014 toxic pollutant and pesticide monitoring.

^c Average from 2014 Part 503 sludge monitoring (8) events.

--- Not monitored in-plant for Part 503.

J Estimated value (below MDL or MRL).

ND Not detected. Duplicate analysis (/).

Beryllium concentrations ranged from 0.05 to 0.08 mg/kg during the bi-monthly sludge sampling during 2014 with an average value of 0.07 mg/kg (Table 13). These concentrations are lower than both the “typical” result from other municipal sludge of 0.313 mg/kg and well within the 95th percentile value reported from other treatment works of 1.168 mg/kg. Nickel ranged from a low of 8.99 mg/kg to a high of 14.3 mg/kg compared to a much higher “typical” concentration of 44.7 mg/kg and a 95th percentile value reported from other treatment works of 662.7 mg/kg. Chromium concentrations in sludge during 2014 ranged from 11.3 to 16.6 mg/kg compared to the typical concentration seen at other POTWs of 230.1 mg/kg. Mercury in the sludge ranged from 0.32 to 0.73 mg/kg with an average mercury concentration calculated at 0.52 mg/kg, below the typical concentration of 1.49 mg/kg seen in other POTW sludge. The other Part 503 metals that were tested, cadmium and lead, also fell well below typical concentrations seen at other facilities.

Other metals that were analyzed, although not a requirement of the Part 503 regulations, were copper, selenium, and zinc. Copper concentrations were below typical concentrations during both the June and August sampling. The zinc concentration was below the typical concentration of 677.6 mg/kg during June and registered 751 mg/kg during August sampling. The selenium values reported for the June and August 2014 sampling events ranged from 2.05 to 2.27 mg/kg, compared to the typical concentration of 1.11 mg/kg and a 95th percentile concentration of 4.848 mg/kg (Table 26).

Table 27 provides an overview of historical sludge data for total metals. In general, year 2014 data indicated similar concentrations of arsenic, beryllium, cadmium, lead, and mercury compared to historical data over the last few years. As discussed in previous reports, both chromium and nickel were found to be elevated during June 2009, but had dropped down to concentrations that were similar to the historic range for the remainder of the 2009 and for all sampling in 2010 through 2014.

5.2 WATER QUALITY MONITORING

5.2.1 Plume Dispersion Sampling

To test the hypothesis that water quality at the ZID boundary was not degraded with respect to water quality at nearfield and control stations, the non-parametric Kruskal-Wallis ANOVA Test (Zar, 1984) was employed which determined whether significant differences occurred within the sample group. If significant differences were observed, an ad hoc multiple range comparison test was utilized to perform pair-wise tests of significance ($\alpha = 0.05$). The results of these tests for the June survey period as a function of water quality parameters are presented in Table 28. Not detect values were replaced with half the detection limit value for statistical testing. In the table, bars are shown under station groupings that were found to be similar (no significant difference) versus those where statistically significant differences were seen.

Data from the receiving water survey showed statistically significant differences in salinity between the three outfall groupings (within-ZID, ZID boundary, and nearfield stations) and the control stations at the surface, middle and bottom depths (Table 28). As can be seen in Table 28, significant differences in temperature were also seen between the control and outfall station grouping at the surface. These differences were the result of the control stations being slightly warmer and less saline; however, though significant differences were found, the variations between station groupings were very small.

Table 27. Historical Discharge Monitoring Data (1986 - Present) for Metals in Sludge in mg/kg.

Year	Arsenic	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel
1986-2008 Min	1.7	<0.02	0.7	3.38	9.8	<0.02	7
1986-2008 Max	151	0.37	10.0	55	468	7.3	53
2009 Avg	3.85	0.49	1.11	26.17	17.70	0.541	59.34
2009 Min	<2.40	<0.240	0.66	7.90	10.60	0.231	7.23
2009 Max	6.34	1.75	1.77	122.0	25.80	0.885	400.0
2010 Avg	4.87	<0.341	1.52	12.53	19.10	0.96	10.94
2010 Min	2.23	<0.314	1.01	7.94	12.60	0.403	7.52
2010 Max	9.21	<0.329	2.53	16.20	24.80	2.140	14.5
2011 Avg	4.76	<0.341	1.30	14.00	17.73	0.72	11.23
2011 Min	3.75	<0.317	0.86	10.80	11.30	0.54	7.71
2011 Max	5.71	<0.364	1.99	17.20	24.10	0.95	13.90
2012 Avg	3.6	<0.05	1.1	11.6	13.5	0.54	11.3
2012 Min	2.8	<0.03	0.7	9.7	9.24	0.19	9.0
2012 Max	4.2	0.08	1.6	14.6	19	0.97	14.4
2013 Avg	4.1	0.07	1.3	15.1	14.2	0.68	13.2
2013 Min	2.8	0.05	0.8	12.1	8.64	0.45	9.2
2013 Max	5.2	0.12	2.2	19.0	18	1.30	20.2
2014 Avg	4.6	0.07	1.25	14.8	15.4	0.53	12.5
2014 Min	2.7	0.05	0.99	11.3	8.8	0.32	8.99
2014 Max	5.8	0.084	1.45	16.7	20.3	0.73	14.8

< Less than Method Detection Limit

Avg Average

Min Minimum

Max MaximumNot Detected at MDL or MRL

In the past, the control stations were often found to be warmer and less saline as a result of increased river influence on the north side of Knik Arm as a result of freshwater inputs from the Matanuska and Knik Rivers. No statistically significant differences were seen for DO, pH, turbidity, color, fecal coliform or TRC for any depth.

All pH values fell well within the AWQS of 6.5 - 8.5 and values did not vary more than 0.2 pH units that would be attributed to the outfall, as required by the AWQS. For color, values ranged from <5.0 to 15 color units with no samples exceeding the AWQS for “Marine Water Uses” that include water supply for aquaculture and contract recreation of “may not exceed 15 color units or the natural conditions, whichever is greater.” In 2007 and 2013 color was found to be elevated at all locations compared to most prior years, and was believed to be due to the naturally high

Table 28. 2014 Station Group Differences at the 5% Significance Level as Determined by the Nonparametric Kruskal-Wallis ANOVA & Multiple Range Tests.

Water Quality Parameter	Water Column Depth		
	Surface	Middle	Bottom
<u>Conventional Analyses*</u>			
Temperature	<u>1 2 3 4</u>	NS	NS
Salinity	<u>1 2 3 4</u>	<u>1 2 3 4</u>	<u>1 2 3 4</u>
Dissolved Oxygen	NS	NS	NS
pH	NS	NS	NS
Turbidity	NS	NS	NS
Color Units ^{HV}	NS	----	----
Fecal Coliform ^{HV}	NS	----	----
Total Residual Chlorine ^{HV}	NS	----	----
<u>Metal and Hydrocarbon Analyses**</u>			
Arsenic	NS ^D , NS ^{TR}	----	----
Cadmium	NS ^D , NS ^{TR}	----	----
Chromium ^{HV}	NS ^D , NS ^{TR}	----	----
Copper	NS ^D , NS ^{TR}	----	----
Mercury	NS ^D , NS ^{TR}	----	----
Nickel	NS ^D , NS ^{TR}	----	----
Lead ^{HV}	NS ^D , NS ^{TR}	----	----
Silver	NS ^D , NS ^{TR}	----	----
Zinc	NS ^D , NS ^{TR}	----	----
Cyanide	NS	----	----
Total Suspended Solids	NS	----	----
Total Aromatic Hydrocarbons (as BETX) ^{HV}	SIG	----	----
Total Aqueous Hydrocarbons (TAQH) ^{HV}	SIG	----	----
Total Petroleum Aromatic Hydrocarbons (TPAH)	NS		

* Tests were performed on four station groups (Group 1: Within-ZID Sites; Group 2: ZID Boundary Sites; Group 3: Nearfield Sites; and Group 4: Control Sites). Results have been **bolded** where significant differences were found. Underlined groups are not significantly different from each other (Multiple Range Test (MRT) result, $p > 0.05$ for eight tests, see: http://www.statsdirect.com/help/nonparametric_methods/krusk.htm).

** Tests were performed on two station groupings: (Drogue F1 stations at the outfall site and Drogue C1 stations at the control site).

---- Not Applicable (surface samples only)

NS Not Significant Kruskal-Wallis Test Result ($p > 0.05$)

SIG Significant Kruskal-Wallis Test Result ($p \leq 0.05$)

^D Dissolved Fraction

^{TR} Total Recoverable Fraction

^{HV} Half the detection limit used in place of data with non-detect values (“<” or “ND”).

suspended sediment levels in the samples from Knik Arm that were not completely removed from the samples during the laboratory analysis. Since 2008 an additional preparation step has been added where color samples are allowed to settle and then decanted in the field prior to submittal to the laboratory. Upon reaching the laboratory the samples are processed by either filtration or centrifuge which provides much more representative sample analysis results.

In addition to the standard water quality sampling, concentrations of total aromatic hydrocarbons (TAH) as BETX and TPAH were measured at the surface at six stations (three at the control site and three at the flood tide outfall site, along the first drogue track). For TAqH and BETX, the outfall stations were found to be statistically significantly higher than the control locations. BETX concentrations at estimated or "J" values (above the MDL but below the MRL) were seen at outfall Stations F1-1, F1-2 and F1-3 and the control Stations C1-1 and C1-2 (toluene only). Only toluene at station F1-1 returned a value above the MRL. All BETX summations were well below the AWQS of 10 µg/L. TAqH concentrations were calculated for all six stations using the MDL as the value for all not detects yielding a maximum of 2.42 µg/L that was seen at Station F1-1, significantly less than the AWQS of 15 µg/L at all locations. All TPAH levels were relatively low.

Total suspended solids, cyanide, and total recoverable and dissolved metals samples collected at the outfall and control sites were also subject to statistical testing. No statistically significant differences were noted for any of these parameters.

A comparison of the water quality data listed in Table 15 with the marine receiving water quality criteria for the State of Alaska (Table 21 and Table 29) indicates that none of the parameters listed in Table 15 exceeded AWQS outside the ZID. All of the TRC concentrations were below the PQL of 10 µg/L for all locations tested. As previously noted, all TRC methods are subject to positive interferences in estuarine or marine waters. Based on the maximum daily effluent TRC concentration 0.94 mg/L (940 µg/L) measured during 2014 and a dilution credit of 180:1 in the NPDES permit, the highest potential estimate of TRC concentration at the ZID boundary would be 5.2 µg/L which meets AWQS at all receiving water locations outside of the ZID. Also, although the TRC analyses were only able to achieve a PQL of 10 µg/L which is slightly higher than the 7.5 µg/L chronic limit, ADEC considers a PQL of 100 µg/L, that is 10 times higher, to be the reasonable and achievable limit for regulatory purposes.

The State's receiving water quality standard for the "growth and propagation of fish, shellfish, aquatic life, and wildlife including seabirds, waterfowl, and furbearers" is 15 µg/L for TAqH and 10 µg/L for TAH. As seen in Table 17, these standards were not exceeded during the receiving water sampling for any location. The highest measurable BETX concentration (Station F1-1) had a total BETX value of 2.02 µg/L; still well below the AWQS of 10 µg/L. In addition, for "contact recreation", the AWQS for hydrocarbons is as follows: "May not cause a film, sheen, or discoloration on the surface or floor of the waterbody or adjoining shorelines. Surface waters must be virtually free from floating oils." No film, sheen, or discoloration was observed during the receiving water sampling program during 2014 and none was observed on adjoining shorelines.

Table 29. State of Alaska Water Quality Standards for Receiving Water.

Parameter	Most Restrictive Marine Water Quality Standards								
Fecal Coliform	Based on a 5-tube decimal dilution test the fecal coliform median MPN may not exceed 14 FC/100 mL (harvesting for consumption of raw mollusks or other raw aquatic life); a geometric mean of 20 FC/100 mL (for aquaculture of products not normally cooked and seafood processing); and not more than ten percent (10%) of the samples may exceed 40 FC/100 mL (aquaculture of products not normally cooked and seafood processing).								
Dissolved Oxygen	Dissolved oxygen concentrations in estuaries and tidal tributaries may not be less than 5.0 mg/L except where natural conditions cause this value to be depressed.								
pH	pH may not be less than 6.5 or greater than 8.5, and may not vary more than 0.2 pH unit outside of the naturally occurring range.								
Turbidity	Turbidity may not exceed the natural conditions.								
Temperature	May not cause the weekly average temperature to increase more than 1° C. The maximum rate of change may not exceed 0.5° C per hour. Normal daily temperature cycles may not be altered in amplitude or frequency.								
Salinity	Maximum allowable variation above natural salinity: <table> <tr> <th>Natural Salinity (‰)</th><th>Human-induced Salinity (‰)</th></tr> <tr> <td>0 to 3.5</td><td>1</td></tr> <tr> <td>>3.5 to 13.5</td><td>2</td></tr> <tr> <td>>13.5 to 35.0</td><td>4</td></tr> </table>	Natural Salinity (‰)	Human-induced Salinity (‰)	0 to 3.5	1	>3.5 to 13.5	2	>13.5 to 35.0	4
Natural Salinity (‰)	Human-induced Salinity (‰)								
0 to 3.5	1								
>3.5 to 13.5	2								
>13.5 to 35.0	4								
Sediment	No measurable increase in concentrations above natural conditions.								
Color	Color shall not exceed 15 color units or the natural conditions, whichever is greater.								
Petroleum Hydrocarbons, Oils and Grease	Total aqueous hydrocarbons (TAqH) in the water column may not exceed 15 µg/L. Total aromatic hydrocarbons (TAH) in the water column may not exceed 10 µg/L. May not cause a film, sheen, or discoloration on the surface or floor of the water-body or adjoining shorelines. Surface waters must be virtually free from floating oils.								
Total Residual Chlorine	May not exceed 13 µg/L (one-hour average) acute and 7.5 µg/L (four-day average) chronic; for marine aquatic life.								
Toxic and Other Deleterious Substances	See Table 21.								

All the dissolved metals tested in receiving water (Table 16) as part of this program met the AWQS as shown in Table 21 at all locations on the ZID boundary and outside of the ZID including the control stations. These included: arsenic, cadmium, copper, chromium, lead, mercury, nickel, silver, and zinc. Testing of antimony, beryllium, selenium, and thallium in receiving water is not required by the permit and was not performed in 2014. Since the adoption of the more appropriate SSWQC for dissolved metals in May 1999 and the adoption of dissolved metals in the AWQS, the receiving waters of Cook Inlet near the Asplund WPCF discharge have always been in compliance with the AWQS.

Cyanide in all receiving water samples collected in 2014 tested below detection limits. The cyanide concentration in the effluent sample that was measured at the same time as part of the receiving water sampling, was reported at a concentration of 1.6 J µg/L and the highest concentration during the 2014 pretreatment sampling efforts was also 1.6 J µg/L, both well below the MAEC of 181 µg/L.

In summation, statistical analyses of the 2014 receiving water quality data indicated that water quality outside the ZID was not degraded with respect to control stations for any parameter as a result of the outfall. Differences that were noted in some parameters such as salinity and temperature were attributed to riverine influences and were not caused by the Asplund WPCF discharge. All AWQS were met in 2014 for the Asplund WPCF receiving water quality program. Although dissolved metal parameters appeared to be slightly elevated at the within ZID station directly over the outfall, all parameters were well below AWQS at all locations located both outside and at the mixing zone boundary. No statistically significant differences between the outfall and control site were seen for any dissolved or total recoverable metal or TSS. BETX and TAqH were significantly different between the outfall and control locations. No statistically significant differences were seen for cyanide between the outfall and control locations and all cyanide and hydrocarbon concentrations were below AWQS at all locations in the receiving water both within and outside the mixing zone boundary.

5.2.2 Fecal Coliform Bacteria

In the past, the ADEC has indicated that one of their primary concerns is bacterial contamination of the shoreline by the Asplund WPCF discharge, indicated by fecal coliform bacteria concentrations. Because the Knik Arm's water uses have not been classified, regulations provide that the most restrictive standard must apply. State marine water quality standards for contact recreation require that the geometric mean fecal coliform concentration taken within a 30-day period not exceed 100 FC/100 mL and that not more than one sample, or more than 10% of the samples if there are more than 10, exceed 200 FC/100 mL. Criteria for secondary recreation and for industrial water supply require that the mean fecal coliform concentration not exceed 200 FC/100 mL and that not more than 10% of the samples exceed 400 FC/100 mL. State marine water quality criteria for the harvesting for consumption of raw mollusks and other raw aquatic life require that, based on a 5-tube decimal dilution test, the median shall not exceed 14 FC/100 mL, and that not more than 10% of the samples shall exceed 43 FC/100 mL. For seafood processing and aquaculture water supply for products not normally cooked, criteria are that the geometric mean may not exceed 20 FC/100 mL, and not more than 10% of the samples shall exceed 40 FC/100 mL. For aquaculture processing water supply for products normally cooked, criteria are that the geometric mean may not exceed 200 FC/100 mL, and not more than 10% of the samples shall exceed 400 FC/100 mL.

Since the harvesting of shellfish and other raw aquatic life is not performed in these waters, and there is no aquaculture or seafood processing, it seems that the criteria for secondary recreation is most applicable; however, these criteria are not the most restrictive. Therefore, the most restrictive criteria used were that the median shall not exceed 14 FC/100 mL (consumption of raw shellfish and other aquatic life), the geometric mean shall not exceed 20 FC/100 mL (seafood processing and aquaculture for raw consumption), and not more than 10% of samples shall exceed 40 FC/100 mL (seafood processing and aquaculture for raw consumption; Table 29).

Statistical tests indicated that fecal coliform concentrations were not significantly different between the within-ZID, ZID boundary, and the nearfield outfall station groups as compared to the control stations (refer to Table 28). Fecal coliform concentrations were very low again this year, and values ranged from <1.8 to 17 FC/100 mL at the outfall stations (including the ZID stations) and a range of <1.8 to 4 FC/100 mL at the control stations. The median at the control stations was <1.8 FC/100 mL, and the median at the all outfall stations was <1.8 FC/100 mL including stations both within and outside the ZID for both ebb and flood tides, well within the 14 FC/100 mL criterion. The control site had a geometric mean of 1.93 FC/100 mL, while that at the outfall stations (inside and outside the ZID) was 2.09 FC/100 mL, both well below the criterion of 20 FC/100 mL. No samples at either the outfall or control stations exceeded the criteria of not more than 10% of the measurements may exceed 40 FC/100 mL. The highest fecal coliform concentration (17 FC/100 mL) was seen this year at outfall Station F1-1 directly over the outfall at low tide.

The range of fecal coliform concentrations for all intertidal samples collected during 2014 was similar to that seen in 2012 and 2013 and ranged from a low of <1.8 to 4.5 FC/100 mL, with a median of <1.8 FC/100 mL and a geometric mean of 2.03 FC/100 mL. These values met the most restrictive water quality criterion of a median of 14 FC/100 mL and a geometric mean of 20 FC/100 mL. Intertidal samples also met the criterion of not more than 10% of the samples may exceed 40 FC 100/mL. In the past, elevated fecal concentrations have sometimes been seen in the intertidal area that were attributed to heavy waterfowl use of the area, and not believed to be the result of the effluent discharge. The area is also heavily used in the summer by hikers that access the beach at Point Woronzof and often use the area for walking their dogs. These high concentrations were not seen in 2014.

Elevated fecal coliform bacteria concentrations were seen in all three of the area creeks that were sampled in 2014 where sampling was performed on the water prior it's to entering Knik Arm. Historical data have indicated that these three streams have had much higher levels of fecal coliform than the waters that were tested in the vicinity of Point Woronzof. The two replicate fecal coliform concentrations measured in Fish Creek were 790 and 790 FC/100 mL. Replicate concentrations measured in Ship Creek were much lower at 49 and 17 FC/100 mL, while those at Chester Creek were 33 and 33 FC/100 mL. The fecal coliform concentrations from Chester, Fish, and Ship Creeks that discharge into Knik Arm were much greater than that seen in the receiving water at the intertidal, outfall, or control locations and also exceeded concentrations seen in Asplund WPCF's effluent.

Fecal coliform concentrations in the effluent samples collected in conjunction with the receiving water, intertidal sampling, and stream sampling was 79 FC/100 mL in both replicates. These values were higher than the range of average monthly effluent values reported for the Asplund WPCF, which in 2014 ranged from 2 to 14 FC/100 mL (Table 8), but within typical daily ranges.

In summary, fecal coliform concentrations in 2014 were found be very low in the receiving water area. No statistically significant differences were seen between station groupings for the ZID, ZID-boundary, or nearfield stations as compared to the control location. Fecal coliform samples collected during the receiving water sampling program met all AWQS criteria, including all outfall stations both within and outside the ZID. Area creeks in 2014 were again found to be elevated but within the historical range for fecal coliform stream concentrations seen in prior years. It is clear from both this data and historic data that area streams are an important source of fecal coliform loading to the receiving waters of Knik Arm and that waterfowl use of the intertidal areas may cause elevated fecal coliform levels that are higher than those being discharged by the Asplund WPCF into Cook Inlet.

6.0 CONCLUSIONS

The following conclusions were based on results from the 2014 monitoring effort as compared to the current NPDES permit and State of Alaska water quality standards:

- The influent, effluent, and sludge chemical monitoring showed, that with no exceptions, the Asplund WPCF met the NPDES permit requirements and complied with all applicable AWQS. AWWU's self-monitoring of TRC, pH, BOD₅, and TSS showed compliance with all permit effluent limitations throughout 2014.
- AWWU's self-monitoring of TRC and pH showed that the permit limit for daily maximum TRC levels in the effluent was never exceeded and pH was within permit limits throughout 2014.
- The permit limit for the monthly maximum geometric mean of 850 FC/100 mL was not exceeded in 2014. The fecal coliform monthly criterion "that not more than 10% of the effluent samples shall exceed 2600 FC/100 mL" was not exceeded in 2014.
- AWWU's self-monitoring of TSS and BOD₅ showed compliance with all regulatory and permit effluent limitations. TSS and BOD₅ were well within the daily, weekly, and monthly criteria for the entire year. Average monthly removals for BOD₅ and TSS of $\geq 30\%$ are required by the amendment to the CWA (40 CFR Part 125; Final Rule). The removal rate for both TSS and BOD₅ met the 30% minimum removal requirement for all months during 2014. Annual removals were 77.3% for TSS and 42.8% for BOD₅ which indicate an exceptional level of primary treatment is being achieved.
- Total aromatic hydrocarbons (TAH), total aqueous hydrocarbons (TAqH), and total ammonia concentrations in the effluent were all found to be below their maximum allowable effluent concentrations (MAECs) as calculated from AWQS throughout 2014.
- Concentrations of metals and cyanide in the effluent never exceeded their MAECs at any time during any of the 2014 monitoring events.
- Concentrations of toxic pollutants and pesticides, including metals and cyanide, in the influent and effluent were all within the established range or lower than values from a national study of secondary treatment plants (EPA, 1982a).
- Toxic pollutant sludge concentrations were found to be very low compared to the limits established under 40 CFR Part 503 and all were within the established range or lower than values from a national study of secondary treatment plants. All metals fell at or below the typical concentrations and all were well below the 95th percentile worst case values (EPA, 1985c).
- Results from quarterly whole effluent toxicity testing were below the permit trigger level that would require additional testing for all tested species and events in 2014.
- Little variation among stations was observed for most hydrographic parameters indicating that the receiving water environment is uniform and well mixed near the outfall.

- To test the hypothesis that the water quality at the ZID boundary was not degraded with respect to the water quality at the nearfield and control stations, statistical comparisons were employed. Two conventional parameters, salinity and temperature, did show statistically significant differences between sites; however, these were not ascribed to the outfall but were due to river influences at the control stations. No statistically significant differences were seen for DO, pH, TRC, TSS, turbidity, or fecal coliform.
- Fecal coliform concentrations in receiving water and intertidal samples were found to be low at all locations. AWQS criteria of a median of not more than 14 FC/100 mL, a geometric mean of not more than 20 FC/100 mL, and of not more than 10% of the samples exceeding 40 FC/100 mL were met at all receiving water and intertidal locations including stations located within the mixing zone boundary.
- Supplemental receiving water quality samples obtained as part of the plume dispersion monitoring indicated that all dissolved metals were below their AWQS at all locations except for one copper sample located at the outfall. No statistically significant differences between the outfall and control station groupings were seen for any dissolved metal. Total metals were elevated compared to the dissolved as a result of the naturally high suspended sediment load. No statistically significant differences were seen for any total recoverable metal.
- All cyanide concentrations in the receiving waters were found to be below the receiving water quality criterion limit of 1.0 µg/L. No statistically significant differences were detected between concentrations at the control and outfall stations.
- Supplemental receiving water samples also demonstrated that TAH and TAqH met the AWQS at all locations.
- TRC was below the detection limit of 10 µg/L at all locations, as compared to the AWQS of 7.5 µg/L for chronic, 13.0 µg/L for acute marine water use, and 100 µg/L as ADEC's practical quantitation limit for regulatory purposes. Based on the highest maximum daily effluent TRC concentration and a 180:1 dilution credit, it is estimated that maximum TRC at the ZID boundary would be 5.2 µg/L and therefore met all AWQS for TRC.
- Turbidity and color met the AWQS at all locations. Turbidity and color did not exceed natural conditions and color did not exceed 15 color units at any receiving water location.

CONCLUSIONS

Results from the past year of the monitoring program confirm years of previous studies, data in the NPDES permit and 301(h) variance renewal application, and the decision by the EPA to reissue the NPDES permit with 301(h) variance. The Asplund WPCF is operating within regulatory requirements with no exceptions during 2014 and is showing no measurable impacts to the marine environment. In addition to the exceptional performance seen in 2014, the Asplund WPCF received the Platinum Award from the National Association of Clean Water Agencies (NACWA) in 2013 after five consecutive years of Gold Awards that were given to Asplund WPCF for exceptional levels of plant performance and permit compliance.

7.0 REFERENCES

- Alaska Department of Environmental Conservation, 1999. Alaska Administrative Code. Water Quality Standards, Chapter 70, (18 AAC 70).
- Alaska Department of Environmental Conservation, 2003. Alaska Administrative Code. Water Quality Standards, Chapter 70, (18 AAC 70).
- Alaska Department of Environmental Conservation, 2008. Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances.
- Alaska Department of Environmental Conservation, 2009. Alaska Administrative Code. Water Quality Standards, Chapter 70, (18 AAC 70).
- American Public Health Association, 1998. Standard Methods for the Examination of Water and Wastewater. 20th Edition. Washington, D.C. Various paging's.
- AWWU, 1998. Request for Site Specific Water Quality Criteria for Point Woronzof Area of Cook Inlet. Submitted to ADEC by Municipality of Anchorage, AWWU.
- AWWU, 2000. 2000 Monitoring Program Plan. Prepared by the Anchorage Water & Wastewater Utility, Treatment Division, Laboratory Services Section.
- CH2M Hill, in association with Ott Water Engineers, Inc., 1984. Application for Modification of Secondary Treatment Requirements, Section 301(h), Clean Water Act. Prepared for Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- CH2M Hill, in association with Ott Water Engineers, Inc., 1985. Amendment to Wastewater Facilities Plan for Anchorage, Alaska. Outfall Improvements. Prepared for Anchorage Water and Wastewater Utilities, Anchorage, Alaska.
- CH2M Hill, 1987. Industrial Waste Pre-treatment Program, Annual Report. Point Woronzof Wastewater Treatment Facility. Prepared for AWWU, Anchorage, Alaska.
- CH2M Hill, in association with Loren Leman, P.E., 1988. Industrial Waste Pre-treatment Program, Annual Report. Point Woronzof Wastewater Treatment Facility. Prepared for the Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- CH2M Hill, 1988. In situ Measurement of Dilution of John M. Asplund Water Pollution Control Facility Effluent in the Cook Inlet at Point Woronzof, Anchorage, Alaska. Prepared for the Municipality of Anchorage.
- CH2M Hill, 1998. NPDES Permit Application for NPDES Permit and 301(h) Variance from Secondary Treatment. John M. Asplund Water Pollution Control Facility. Prepared for the Anchorage Water and Wastewater Utility, Municipality of Anchorage, Alaska.
- CH2M Hill, 2011. Evaluation of the Effects of Discharge Permit Reauthorization on Endangered Species, Anchorage Water and Wastewater Utility, John M. Asplund Water

- Pollution Control Facility. Final Draft. Submitted to Anchorage Water and Wastewater Utility. Submitted by CH2M Hill.
- Code of Federal Regulations, 1999. 40 CFR Parts 104; 125; 136; 401; and 503. Title 40. Protection of Environment, U.S. Government Printing Office, Washington, D.C.
- Dunn, Olive Jean, 1964. Multiple Comparisons Using Rank Sums. *Technometrics*, Vol. 6, No. 3:241.
- Dzombak, D.A., R.S. Ghosh, and G.M. Wong-Chong. 2005. *Cyanide in Water and Soil – Chemistry, Risk, and Management*. CRC Press, Taylor & Francis.
- EPA, 1976. *Quality Criteria for Water*. U.S. Environmental Protection Agency, Washington, D.C. U.S. Government Printing Office: 1977, 0-222-904.
- EPA, 1978. *Microbiological Methods for Monitoring the Environment*. U.S. Environmental Protection Agency, EPA 600/18-78-017.
- EPA, 1980. *Ambient Water Quality Criteria listed under Section 304(a)(1) of the Clean Water Act*, October 1980, EPA 440/5-90-015 through EPA 440/5-90-079, Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C.
- EPA, 1982a. *Fate of Priority Pollutants in Publicly Owned Treatment Works. Final Report, Volume 1*, EPA 440/1-82/303, Effluent Guidelines Division, WH-552.
- EPA, 1982b. *Design of 301(h) Monitoring Programs for Municipal Wastewater Discharges to Marine Waters*. EPA 430/9-82-010.
- EPA, 1983. *Methods for Chemical Analysis of Water and Wastes*. U. S. Environmental Protection Agency, EPA 600/4-79/020, revised March 1983.
- EPA, 1985a. *Final NPDES Permit No. AK-002255-1 and attached Response to Comments on the Tentative Decision Document and Draft Permit for the John M. Asplund Water Pollution Control Facility*. Prepared by the EPA 301(h) Review Team, Region 10. September 1985.
- EPA, 1985b. *Analysis of the Section 301(h), Secondary Treatment Variance Application for the John M. Asplund Water Pollution Control Facility*. Prepared by the EPA 301(h) Review Team, Region 10. September, 1985.
- EPA, 1985c. *Summary of Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge: Methods and Results*. EPA 822/S-85-001. Office of Water Regulations and Standards, Wastewater Criteria Branch, U.S. Environmental Protection Agency, Washington, D.C.
- EPA, 1986a. *Test Methods for Evaluating Solid Waste*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. EPA SW 846.

- EPA, 1986b. Quality Criteria for Water, U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C. EPA 440/5-86-001.
- EPA, 1988. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms. EPA 600/4-87/028.
- EPA, 1989. Ambient Aquatic Life Water Quality Criteria for Ammonia (Saltwater). EPA 440/5-88-004.
- EPA, 1992. Interim Guidance on Interpretation and Implementation of Aquatic Life Criteria for Metals. Health and Ecological Criteria Division, Office of Science and Technology. U.S. Environmental Protection Agency, Washington, D.C.
- EPA, 1993. Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria. October 1, 1993 Memorandum from Martha G. Prothro, Acting Assistant Administrator for Water to EPA Regions I-X.
- EPA, 1994a. U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. U. S. Environmental Protection Agency, Office of Emergency and Remedial Response. EPA 540/R-94/013.
- EPA, 1994b. U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. U. S. Environmental Protection Agency, Office of Emergency and Remedial Response. EPA 540/R-94/012.
- EPA, 1994c. Water Quality Standards Handbook: Second Edition. Office of Water (4305). EPA-823-B-94-005a. U.S. Environmental Protection Agency, Water Quality Standards Branch, Office of Science and Technology, Washington, D.C.
- EPA, 1995. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms. First Edition. U. S. Environmental Protection Agency, National Exposure Research Laboratory, Cincinnati, OH. EPA 600/R-95-136.
- EPA, 1999a. Method 1664, Revision A. n-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated n-Hexane Extractable Material (SGT-HEM; Non-polar Material) by Extraction and Gravimetry. February 1999. EPA-821-R-98-002.
- EPA, 1999b. Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants. EPA 833-B-99-002.
- EPA, 2000. Final NPDES Permit No. AK-002255-1 and attached Response to Comments on the Tentative Decision Document and Draft Permit for the John M. Asplund Water Pollution Control Facility. Prepared by the EPA 301(h) Review Team, Region 10. June 2000.
- EPA, 2001. September 28, 2001; Letter to Michele Brown, Commissioner, ADEC, from Randall Smith, Director, Office of Water, Environmental Protection Agency.

- EPA, 2006. September 15, 2006; Letter to Lynn J. Tomich Kent, Director, Division of Water, ADEC, from Michael F. Gearheard, Director, Office of Water, Environmental Protection Agency.
- EPA and Jones & Stokes Associates, Inc., 1982. Draft Environmental Impact Statement. Municipality of Anchorage Sewage Facilities Plan, Anchorage, Alaska. November 1982.
- ERM, 2014. 40 CFR Part 503 - Site Specific Sludge Limit Calculations Based on Asplund Water Pollution Control Facility Incinerator Source Testing. Prepared for the Anchorage Water and Wastewater Utility, Municipality of Anchorage, Alaska.
- Long, E.R., D.D. Macdonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. *Environ. Management*. 19: 81-97.
- Kinnetic Laboratories, Inc., 1979. Supplemental Studies of Anchorage Wastewater Discharge off Point Woronzof in Upper Cook Inlet. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska, R-79-13.
- Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, in association with R.W. Hoffman, Ph.D., 1987a. Point Woronzof Monitoring Program, Annual Report, October 1985-1986. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, in association with R. W. Hoffman, Ph.D., 1987b. Point Woronzof Monitoring Program, Annual Report, November 1986-October 1987. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1988. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1987-October 1988. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1989. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1988-October 1989. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1991. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1989-October 1990. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1992. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1990-October 1991. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1993. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1991-October 1992. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1994. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1992-October 1993. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1995. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1993-October 1994. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1996. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1994-October 1995. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1997. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1995-October 1996. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1998. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1996-October 1997. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1999. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1997-October 1998. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., 2000a. Point Woronzof Wastewater Treatment Facility, Monitoring Program Work Plan, October 2000. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., 2000b. Point Woronzof Wastewater Treatment Facility, Initial Investigation - Toxicity Reduction Evaluation (TRE) Work Plan, October 2000. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 2000c. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1998-October 1999. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

- Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 2001. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, January – December 2000. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2002. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, January – December 2001. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2003. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, January – December 2002. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2004. Anchorage Water and Wastewater Utility, John M. Asplund Water Pollution Control Facility at Point Woronzof. Monitoring Program Annual Report, January – December 2003. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2005. Anchorage Water and Wastewater Utility, John M. Asplund Water Pollution Control Facility at Point Woronzof. Monitoring Program Annual Report, January – December 2004. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2006. Anchorage Water and Wastewater Utility, John M. Asplund Water Pollution Control Facility at Point Woronzof. Monitoring Program Annual Report, January – December 2005. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2007a. Anchorage Water and Wastewater Utility, John M. Asplund Water Pollution Control Facility at Point Woronzof. Monitoring Program Annual Report, January – December 2006. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2007b. Current and Suspended Sediment Investigation, Knik Arm – Cook Inlet, Alaska. Data Report prepared for Knik Arm Bridge and Toll Authority, HDR Alaska, Inc., and URS Corporation by Kinnetic Laboratories, Inc., Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2008. Anchorage Water and Wastewater Utility, John M. Asplund Water Pollution Control Facility at Point Woronzof. Monitoring Program Annual Report, January – December 2007. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2009. Anchorage Water and Wastewater Utility, John M. Asplund Water Pollution Control Facility at Point Woronzof. Monitoring Program Annual Report, January – December 2008. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2010. Anchorage Water and Wastewater Utility, John M. Asplund Water Pollution Control Facility at Point Woronzof. Monitoring Program Annual

- Report, January – December 2009. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2011. Anchorage Water and Wastewater Utility, John M. Asplund Water Pollution Control Facility at Point Woronzof. Monitoring Program Annual Report, January – December 2010. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2012a. Anchorage Water and Wastewater Utility, John M. Asplund Water Pollution Control Facility at Point Woronzof. Monitoring Program Annual Report, January – December 2011. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc., 2012b. Point Woronzof Wastewater Treatment Facility, Monitoring Program Work Plan, Updated 2012. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2013. Anchorage Water and Wastewater Utility, John M. Asplund Water Pollution Control Facility at Point Woronzof. Monitoring Program Annual Report, January – December 2012. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- Kinnetic Laboratories, Inc. 2014. Anchorage Water and Wastewater Utility, John M. Asplund Water Pollution Control Facility at Point Woronzof. Monitoring Program Annual Report, January – December 2013. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.
- NOAA/NOS, 2014. Tides and Currents, High and Low Water Predictions, West Coast of North and South America - Anchorage, Alaska. National Oceanic and Atmospheric Administration, National Ocean Service, U.S. Department of Commerce.
- Ott Water Engineers, Inc., Quadra Engineering, Inc., and Black and Veatch Consulting Engineers, 1982. Wastewater Facilities Plan for Anchorage, Alaska. Prepared for Anchorage Water and Wastewater Utilities, Anchorage, Alaska.
- Sombardier, L. and P.P. Niiler, 1994. Global Surface Circulation Measured by Lagrangian Drifters. Sea Technology, October 1994. pp. 21-24.
- UNESCO and National Institute of Great Britain, 1973. International Oceanographic Tables, Volume 2 (82 pp.)
- Zar, J.H. 1984. Biostatistical Analysis. Second Addition. Prentice-Hall, Inc., Englewood Cliffs, NJ. 718 pp.